



THINK PROJECT NUMBER: 20015

PROJECT MANUAL & SPECIFICATIONS

LAYTON FIRE STATION #54/ LAYTON FIRE DEPARTMENT

1100 NORTH VALLEY VIEW DRIVE
LAYTON, UTAH 84040

November 11, 2020



SPECIFICATIONS: TABLE OF CONTENTS

Project Administration Subgroup

DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS

00 0101	PROJECT TITLE PAGE
00 2113	INSTRUCTIONS TO BIDDERS AIA Document A701 – 2018 Instruction to Bidders
00 2213	SUPPLEMENTARY INSTRUCTIONS TO BIDDERS AIA Document A201 – 2007 General Conditions of the Contract for Construction
00 2213.00	Supplementary Instructions to Bidders
00 3132	GEOTECHNICAL DATA
00 4133	BID SECURITY FORMS AIA Document A312 – 2010 Performance Bond AIA Document A310 – 2010 Bid Bond
	Agreement For Use of Digital Data - Form
	AIA Document E203 – 2013 Building Information Modeling and Digital Data Exhibit Contracts
	AIA Document A101 – 2017 Standard Form of Agreement Between Owner and Contractor
	AIA Document A101 – 2017 Exhibit A Insurance and Bonds

GeoTechnical Soils Investigation Report

DIVISION 01 – GENERAL REQUIREMENTS

01 1000	SUMMARY
01 2500	SUBSTITUTION PROCEDURES
01 2600	CONTRACT MODIFICATION PROCEDURES
01 2900	PAYMENT PROCEDURES
01 3100	PROJECT MANAGEMENT AND COORDINATION
01 3200	CONSTRUCTION PROGRESS DOCUMENTATION
01 3300	SUBMITTAL PROCEDURES
01 4000	QUALITY REQUIREMENTS
01 4200	REFERENCES
01 5000	TEMPORARY FACILITIES AND CONTROLS
01 6000	PRODUCTS REQUIREMENTS
01 7300	EXECUTION
01 7700	CLOSEOUT PROCEDURES
01 7823	OPERATION AND MAINTENANCE DATA
01 7839	PROJECT RECORD DOUMENTS
01 9113	GENERAL COMMISSIONING REQUIREMENTS

Facility Construction Subgroup

DIVISION 03 – CONCRETE

- 03 3000 CAST-IN-PLACE CONCRETE
- 03 4500 PRECAST ARCHITECTURAL CONCRETE

DIVISION 04–MASONRY

- 04 2200 CONCRETE UNIT MASONRY
- 04 7300 SIMULATED STONE VENEER

DIVISION 05 - METALS

- 05 1200 STRUCTURAL STEEL FRAMING
- 05 5000 METAL FABRICATIONS
- 05 5213 PIPE AND TUBE RAILINGS

DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES

- 06 1053 MISCELLANEOUS ROUGH CARPENTRY
- 06 1600 SHEATHING
- 06 4023 INTERIOR ARCHITECTURAL WOODWORK
- 06 4512 ARCHITECTURAL WOOD TRIM

DIVISION 07–THERMAL AND MOISTURE PROTECTION

- 07 1326 SELF ADHERING SHEET WATERPROOFING
- 07 2100 THERMAL INSULATION
- 07 2500 WEATHER BARRIERS
- 07 4113.16 STANDING-SEAM METAL ROOF PANELS
- 07 4213.53 METAL SOFFIT PANELS
- 07 6200 SHEET METAL FLASHING AND TRIM
- 07 7200 ROOF ACCESSORIES
- 07 7253 SNOW GUARDS
- 07 8413 PENETRATION FIRESTOPPING
- 07 8443 JOINT FIRESTOPPING
- 07 9200 JOINT SEALANTS

DIVISION 08 – OPENINGS

- 08 1113 HOLLOW METAL DOORS AND FRAMES
- 08 1416 FLUSH WOOD DOORS
- 08 3323 OVERHEAD SECTIONAL DOORS
- 08 4113 ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS
- 08 5113 ALUMINUM WINDOWS
- 08 7100 DOOR HARDWARE

08 8000 GLAZING

DIVISION 09 – FINISHES

09 2216 NON-STRUCTURAL METAL FRAMING
09 2900 GYPSUM BOARD
09 3000 TILING
09 5113 ACOUSTICAL PANEL CEILING
09 6519 RUBBER FLOORING
09 6813 TILE CARPETING
09 9113 EXTERIOR PAINTING
09 9123 INTERIOR PAINTING
09 9600 HIGH-PERFORMANCE COATINGS
09 9656 EPOXY FLOOR COATINGS
09 9726 CEMENTITIOUS COATINGS

DIVISION 10 – SPECIALTIES

10 1400 SIGNAGE
10 2800 TOILET AND BATH ACCESSORIES
10 4413 FIRE EXTINGUISHER CABINETS
10 4416 FIRE EXTINGUISHERS
10 5113 METAL LOCKERS
10 7500 FLAGPOLES

DIVISION 11 – EQUIPMENT

11 3100 RESIDENTIAL APPLIANCES & SPECIAL LAUNDRY EQUIPMENT

DIVISION 12 – FURNISHINGS

12 3200 MANUFACTURED PLASTIC LAMINATE FACED CASEWORK
12 3640 STONE COUNTERTOPS

DIVISION 13 – SPECIAL CONSTRUCTION

13 4000 FIREFIGHTER SLIDE POLS

DIVISION 14 – CONVEYING EQUIPMENT

14 2100 ELECTRIC TRACTION ELEVATORS

DIVISION 21 – FIRE SUPPRESSION

21 1313 WET PIPE SPRINKLER SYSTEMS
21 1316 DRY PIPE SPRINKLER SYSTEMS

DIVISION 22 – PLUMBING

22 0513 COMMON MOTOR REQUIREMENTS
22 0516 EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
22 0517 SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING
22 0518 ESCUTCHEONS FOR PLUMBING PIPING

22 0519 METERS AND GAGES FOR PLUMBING PIPING
22 0523 GENERAL-DUTY VALVES FOR PLUMBING PIPING
22 0529 HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT
22 0553 IDENTIFICATION FOR PLUMBING PIPING
22 0719 PLUMBING PIPING INSULATION
22 0800 PLUMBING SYSTEMS COMMISSIONING
22 1116 DOMESTIC WATER PIPING
22 1119 DOMESTIC WATER PIPING SPECIALTIES
22 1123 DOMESTIC WATER PUMPS
22 1316 SANITARY WASTE AND VENT PIPING
22 1319 SANITARY WASTE PIPING SPECIALTIES
22 1323 SANITARY WASTE INTERCEPTORS
22 1513 GENERAL-SERVICE COMPRESSED-AIR PIPING
22 1519 GENERAL-SERVICE PACKAGED AIR COMPRESSORS AND RECEIVERS
22 3400 FUEL-FIRED, DOMESTIC-WATER HEATERS
22 4213.13 COMMERCIAL WATER CLOSETS
22 4213.16 COMMERCIAL URINALS
22 4216.13 COMMERCIAL SINKS
22 4223 COMMERCIAL SHOWERS
22 4713 DRINKING FOUNTAINS

DIVISION 23 – HEATING VENTILATING AND AIR CONDITIONING

23 0513 COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
23 0516 EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING
23 0517 SLEEVES AND SLEEVE SEALS FOR HVAC PIPING
23 0519 METERS AND GAGES FOR HVAC PIPING
23 0529 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
23 0548 VIBRATION AND SEISMIC CONTROLS FOR HVAC
23 0553 IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
23 0593 TESTING, ADJUSTING, AND BALANCING FOR HVAC
23 0713 DUCT INSULATION
23 0923 DIRECT DIGITAL CONTROL (DGC) SYSTEM FOR HVAC
23 1123 FACILITY NATURAL-GAS PIPING
23 2113 HYDRONIC PIPING
23 2116 HYDRONIC PIPING SPECIALTIES
23 2123 HYDRONIC PUMPS
23 2300 REFRIGERANT PIPING
23 2513 WATER TREATMENT FOR CLOSED-LOOP HYDRONIC SYSTEMS
23 3113 METAL DUCTS
23 3300 AIR DUCT ACCESSORIES
23 3423 HVAC POWER VENTILATORS
23 3439 HIGH VOLUME LOW SPEED FANS
23 3713 DIFFUSERS, REGISTERS, AND GRILLES
23 3813 COMMERCIAL-KITCHEN HOODS
23 5116 FABRICATED BREECHINGS AND ACCESSORIES
23 5216 CONDENSING BOILERS

- 23 5416.13 GAS FIRED FURNACES
- 23 5523.13 LOW INTENSITY GAS FIRED RADIANT HEATERS
- 23 6200 PACKAGED COMPRESSOR AND CONDENSER UNITS
- 23 8126 SPLIT-SYSTEM AIR-CONDITIONERS
- 23 8239.19 WALL AND CEILING UNIT HEATERS

DIVISION 26 - ELECTRICAL

- 26 0500 COMMON WORK RESULTS FOR ELECTRICAL
- 26 0519 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
- 26 0526 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
- 26 0529 HANGERS & SUPPORTS FOR ELECTRICAL SYSTEMS
- 26 0533 RACEWAYS & BOXES FOR ELECTRICAL SYSTEMS
- 26 0536 CABLE TRAYS FOR ELECTRICAL SYSTEMS
- 26 0548 VIBRATION & SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS
- 26 0553 IDENTIFICATION OF ELECTRICAL SYSTEMS
- 26 0572 OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY
- 26 0573 OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY
- 26 0574 OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY
- 26 0923 LIGHTING CONTROL DEVICES
- 26 0943 NETWORK LIGHTING CONTROLS
- 26 2413 SWITCHBOARDS
- 26 2416 PANELBOARDS
- 26 2726 WIRING DEVICES
- 26 2726.1 WIRING DEVICE SCHEDULE
- 26 2813 FUSES
- 26 2816 ENCLOSED SWITCHES AND CIRCUIT BREAKERS
- 26 2913 ENCLOSED CONTROLLERS
- 26 3213 ENGINE GENERATORS
- 26 3600 TRANSFER SWITCHES
- 26 4313 SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS
- 26 5100 INTERIOR LIGHTING
- 26 5600 EXTERIOR LIGHTING

DIVISION 27 – COMMUNICATIONS

- 27 1100 TELECOMMUNICATIONS PATHWAYS AND SPACES
- 27 1300 COMMUNICATION BACKBONE CABLING
- 27 1500 COMMUNICATIONS HORIZONTAL CABLING

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

- 28 1300 ACCESS CONTROL
- 28 1316 SECURITY AND DATABASE MANAGEMENT SYSTEM
- 28 3111 DIGITAL ADDRESSABLE FIRE ALARM SYSTEM

Site and Infrastructure Subgroup

DIVISION 31 – EARTHWORK

- 31 1000 SITE CLEARING
- 31 2000 EARTH MOVING
- 31 2319 DEWATERING
- 31 2500 EROSION AND SEDIMENTATION CONTROL
- 31 5000 EXCAVATION SUPPORT AND PROTECTION

DIVISION 32 – EXTERIOR IMPROVEMENTS

- 32 1216 ASPHALT PAVING
- 32 1313 CONCRETE PAVING
- 32 1373 CONCRETE PAVING JOINT SEALANTS
- 32 1723 PAVEMENT MARKINGS
- 32 1726 TACTILE WARNING SURFACING
- 32 8400 PLANTING IRRIGATION
- 32 9115 SOIL PREPARATION
- 32 9122 TOPSOIL GRADING
- 32 9223 SODDING
- 32 9300 PLANTS

DIVISION 33 – UTILITIES

- 33 1113 FACILITY WATER DISTRIBUTION PIPING
- 33 1313 FACILITY SANITARY SEWERS
- 33 4100 STORM UTILITY DRAINAGE PIPING
- 33 7173 ELECTRICAL UTILITIES SERVICE

END OF TABLE OF CONTENTS

DOCUMENT 00 0101 - PROJECT TITLE PAGE

PROJECT MANUAL

LAYTON FIRE STATION #54 LAYTON FIRE DEPARTMENT
1100 NORTH VALLEY VIEW DRIVE
LAYTON, UTAH 84040

Architect Project No. 20015

Architect: Corey Solum, AIA
Project Manager: Jim Poloncic

7927 High Point Parkway, Suite 300
Sandy, Utah 84094
Phone: (801) 269-0055
Fax: (801) 269-1425

Web Site: www.thinkaec.com

Issued: November 11th, 2020

Copyright © 2020 THINK Architecture, Inc., All rights reserved.

END OF DOCUMENT 00 0101

DOCUMENT 002113 - INSTRUCTIONS TO BIDDERS

1.1 INSTRUCTIONS TO BIDDERS

- A. AIA Document A701, "Instructions to Bidders," is hereby incorporated into the Procurement and Contracting Requirements by reference.
 - 1. A copy of AIA Document A701, "Instructions to Bidders," is bound in this Project Manual.

- B. Project Bid Tabulation Form, "" is hereby incorporated into the Procurement and Contracting Requirements by reference.
 - 1. A copy of project bid form is bound in this Project Manual.

END OF DOCUMENT 002113

AIA[®] Document A701[™] – 2018

Instructions to Bidders

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

Layton City Fire Station 54
Layton, Utah
New Fire Station for Layton City per City RFP and Architects Proposal

THE OWNER:
(Name, legal status, address, and other information)

Layton City, General Corporation
437 North Wasatch Drive
Layton, Utah 84041

THE ARCHITECT:
(Name, legal status, address, and other information)

Think Architecture, Inc., Subchapter S Corporation
7927 High Point Pkwy, Ste 300
Sandy, UT 84094
Telephone Number: (801) 269-0055
Fax Number: (801) 269-1425

TABLE OF ARTICLES

- 1 **DEFINITIONS**
- 2 **BIDDER'S REPRESENTATIONS**
- 3 **BIDDING DOCUMENTS**
- 4 **BIDDING PROCEDURES**
- 5 **CONSIDERATION OF BIDS**
- 6 **POST-BID INFORMATION**
- 7 **PERFORMANCE BOND AND PAYMENT BOND**
- 8 **ENUMERATION OF THE PROPOSED CONTRACT DOCUMENTS**

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.

FEDERAL, STATE, AND LOCAL LAWS MAY IMPOSE REQUIREMENTS ON PUBLIC PROCUREMENT CONTRACTS. CONSULT LOCAL AUTHORITIES OR AN ATTORNEY TO VERIFY REQUIREMENTS APPLICABLE TO THIS PROCUREMENT BEFORE COMPLETING THIS FORM.

It is intended that AIA Document G612[™]-2017, Owner's Instructions to the Architect, Parts A and B will be completed prior to using this document.

ARTICLE 1 DEFINITIONS

§ 1.1 Bidding Documents include the Bidding Requirements and the Proposed Contract Documents. The Bidding Requirements consist of the advertisement or invitation to bid, Instructions to Bidders, supplementary instructions to bidders, the bid form, and any other bidding forms. The Proposed Contract Documents consist of the unexecuted form of Agreement between the Owner and Contractor and that Agreement's Exhibits, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, all Addenda, and all other documents enumerated in Article 8 of these Instructions.

§ 1.2 Definitions set forth in the General Conditions of the Contract for Construction, or in other Proposed Contract Documents apply to the Bidding Documents.

§ 1.3 Addenda are written or graphic instruments issued by the Architect, which, by additions, deletions, clarifications, or corrections, modify or interpret the Bidding Documents.

§ 1.4 A Bid is a complete and properly executed proposal to do the Work for the sums stipulated therein, submitted in accordance with the Bidding Documents.

§ 1.5 The Base Bid is the sum stated in the Bid for which the Bidder offers to perform the Work described in the Bidding Documents, to which Work may be added or deleted by sums stated in Alternate Bids.

§ 1.6 An Alternate Bid (or Alternate) is an amount stated in the Bid to be added to or deducted from, or that does not change, the Base Bid if the corresponding change in the Work, as described in the Bidding Documents, is accepted.

§ 1.7 A Unit Price is an amount stated in the Bid as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, as described in the Bidding Documents.

§ 1.8 A Bidder is a person or entity who submits a Bid and who meets the requirements set forth in the Bidding Documents.

§ 1.9 A Sub-bidder is a person or entity who submits a bid to a Bidder for materials, equipment, or labor for a portion of the Work.

ARTICLE 2 BIDDER'S REPRESENTATIONS

§ 2.1 By submitting a Bid, the Bidder represents that:

- .1 the Bidder has read and understands the Bidding Documents;
- .2 the Bidder understands how the Bidding Documents relate to other portions of the Project, if any, being bid concurrently or presently under construction;
- .3 the Bid complies with the Bidding Documents;
- .4 the Bidder has visited the site, become familiar with local conditions under which the Work is to be performed, and has correlated the Bidder's observations with the requirements of the Proposed Contract Documents;
- .5 the Bid is based upon the materials, equipment, and systems required by the Bidding Documents without exception; and
- .6 the Bidder has read and understands the provisions for liquidated damages, if any, set forth in the form of Agreement between the Owner and Contractor.

ARTICLE 3 BIDDING DOCUMENTS

§ 3.1 Distribution

§ 3.1.1 Bidders shall obtain complete Bidding Documents, as indicated below, from the issuing office designated in the advertisement or invitation to bid, for the deposit sum, if any, stated therein.

(Indicate how, such as by email, website, host site/platform, paper copy, or other method Bidders shall obtain Bidding Documents.)

§ 3.1.2 Any required deposit shall be refunded to Bidders who submit a bona fide Bid and return the paper Bidding Documents in good condition within ten days after receipt of Bids. The cost to replace missing or damaged paper documents will be deducted from the deposit. A Bidder receiving a Contract award may retain the paper Bidding Documents, and the Bidder's deposit will be refunded.

§ 3.1.3 Bidding Documents will not be issued directly to Sub-bidders unless specifically offered in the advertisement or invitation to bid, or in supplementary instructions to bidders.

§ 3.1.4 Bidders shall use complete Bidding Documents in preparing Bids. Neither the Owner nor Architect assumes responsibility for errors or misinterpretations resulting from the use of incomplete Bidding Documents.

§ 3.1.5 The Bidding Documents will be available for the sole purpose of obtaining Bids on the Work. No license or grant of use is conferred by distribution of the Bidding Documents.

§ 3.2 Modification or Interpretation of Bidding Documents

§ 3.2.1 The Bidder shall carefully study the Bidding Documents, shall examine the site and local conditions, and shall notify the Architect of errors, inconsistencies, or ambiguities discovered and request clarification or interpretation pursuant to Section 3.2.2.

§ 3.2.2 Requests for clarification or interpretation of the Bidding Documents shall be submitted by the Bidder in writing and shall be received by the Architect at least seven days prior to the date for receipt of Bids.
(Indicate how, such as by email, website, host site/platform, paper copy, or other method Bidders shall submit requests for clarification and interpretation.)

§ 3.2.3 Modifications and interpretations of the Bidding Documents shall be made by Addendum. Modifications and interpretations of the Bidding Documents made in any other manner shall not be binding, and Bidders shall not rely upon them.

§ 3.3 Substitutions

§ 3.3.1 The materials, products, and equipment described in the Bidding Documents establish a standard of required function, dimension, appearance, and quality to be met by any proposed substitution.

§ 3.3.2 Substitution Process

§ 3.3.2.1 Written requests for substitutions shall be received by the Architect at least ten days prior to the date for receipt of Bids. Requests shall be submitted in the same manner as that established for submitting clarifications and interpretations in Section 3.2.2.

§ 3.3.2.2 Bidders shall submit substitution requests on a Substitution Request Form if one is provided in the Bidding Documents.

§ 3.3.2.3 If a Substitution Request Form is not provided, requests shall include (1) the name of the material or equipment specified in the Bidding Documents; (2) the reason for the requested substitution; (3) a complete description of the proposed substitution including the name of the material or equipment proposed as the substitute, performance and test data, and relevant drawings; and (4) any other information necessary for an evaluation. The request shall include a statement setting forth changes in other materials, equipment, or other portions of the Work, including changes in the work of other contracts or the impact on any Project Certifications (such as LEED), that will result from incorporation of the proposed substitution.

§ 3.3.3 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.

§ 3.3.4 If the Architect approves a proposed substitution prior to receipt of Bids, such approval shall be set forth in an Addendum. Approvals made in any other manner shall not be binding, and Bidders shall not rely upon them.

§ 3.3.5 No substitutions will be considered after the Contract award unless specifically provided for in the Contract Documents.

§ 3.4 Addenda

§ 3.4.1 Addenda will be transmitted to Bidders known by the issuing office to have received complete Bidding Documents.

(Indicate how, such as by email, website, host site/platform, paper copy, or other method Addenda will be transmitted.)

§ 3.4.2 Addenda will be available where Bidding Documents are on file.

§ 3.4.3 Addenda will be issued no later than four days prior to the date for receipt of Bids, except an Addendum withdrawing the request for Bids or one which includes postponement of the date for receipt of Bids.

§ 3.4.4 Prior to submitting a Bid, each Bidder shall ascertain that the Bidder has received all Addenda issued, and the Bidder shall acknowledge their receipt in the Bid.

ARTICLE 4 BIDDING PROCEDURES

§ 4.1 Preparation of Bids

§ 4.1.1 Bids shall be submitted on the forms included with or identified in the Bidding Documents.

§ 4.1.2 All blanks on the bid form shall be legibly executed. Paper bid forms shall be executed in a non-erasable medium.

§ 4.1.3 Sums shall be expressed in both words and numbers, unless noted otherwise on the bid form. In case of discrepancy, the amount entered in words shall govern.

§ 4.1.4 Edits to entries made on paper bid forms must be initialed by the signer of the Bid.

§ 4.1.5 All requested Alternates shall be bid. If no change in the Base Bid is required, enter "No Change" or as required by the bid form.

§ 4.1.6 Where two or more Bids for designated portions of the Work have been requested, the Bidder may, without forfeiture of the bid security, state the Bidder's refusal to accept award of less than the combination of Bids stipulated by the Bidder. The Bidder shall neither make additional stipulations on the bid form nor qualify the Bid in any other manner.

§ 4.1.7 Each copy of the Bid shall state the legal name and legal status of the Bidder. As part of the documentation submitted with the Bid, the Bidder shall provide evidence of its legal authority to perform the Work in the jurisdiction where the Project is located. Each copy of the Bid shall be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid by a corporation shall further name the state of incorporation and have the corporate seal affixed. A Bid submitted by an agent shall have a current power of attorney attached, certifying the agent's authority to bind the Bidder.

§ 4.1.8 A Bidder shall incur all costs associated with the preparation of its Bid.

§ 4.2 Bid Security

§ 4.2.1 Each Bid shall be accompanied by the following bid security:

(Insert the form and amount of bid security.)

None

§ 4.2.2 The Bidder pledges to enter into a Contract with the Owner on the terms stated in the Bid and shall, if required, furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder. Should the Bidder refuse to enter into such Contract or fail to furnish such bonds if required, the amount of the bid security shall be forfeited to the Owner as liquidated damages, not as a penalty. In the event the Owner fails to comply with Section 6.2, the amount of the bid security shall not be forfeited to the Owner.

§ 4.2.3 If a surety bond is required as bid security, it shall be written on AIA Document A310™, Bid Bond, unless otherwise provided in the Bidding Documents. The attorney-in-fact who executes the bond on behalf of the surety shall affix to the bond a certified and current copy of an acceptable power of attorney. The Bidder shall provide surety bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

§ 4.2.4 The Owner will have the right to retain the bid security of Bidders to whom an award is being considered until (a) the Contract has been executed and bonds, if required, have been furnished; (b) the specified time has elapsed so that Bids may be withdrawn; or (c) all Bids have been rejected. However, if no Contract has been awarded or a Bidder has not been notified of the acceptance of its Bid, a Bidder may, beginning days after the opening of Bids, withdraw its Bid and request the return of its bid security.

§ 4.3 Submission of Bids

§ 4.3.1 A Bidder shall submit its Bid as indicated below:

(Indicate how, such as by website, host site/platform, paper copy, or other method Bidders shall submit their Bid.)

§ 4.3.2 Paper copies of the Bid, the bid security, and any other documents required to be submitted with the Bid shall be enclosed in a sealed opaque envelope. The envelope shall be addressed to the party receiving the Bids and shall be identified with the Project name, the Bidder's name and address, and, if applicable, the designated portion of the Work for which the Bid is submitted. If the Bid is sent by mail, the sealed envelope shall be enclosed in a separate mailing envelope with the notation "SEALED BID ENCLOSED" on the face thereof.

§ 4.3.3 Bids shall be submitted by the date and time and at the place indicated in the invitation to bid. Bids submitted after the date and time for receipt of Bids, or at an incorrect place, will not be accepted.

§ 4.3.4 The Bidder shall assume full responsibility for timely delivery at the location designated for receipt of Bids.

§ 4.3.5 A Bid submitted by any method other than as provided in this Section 4.3 will not be accepted.

§ 4.4 Modification or Withdrawal of Bid

§ 4.4.1 Prior to the date and time designated for receipt of Bids, a Bidder may submit a new Bid to replace a Bid previously submitted, or withdraw its Bid entirely, by notice to the party designated to receive the Bids. Such notice shall be received and duly recorded by the receiving party on or before the date and time set for receipt of Bids. The receiving party shall verify that replaced or withdrawn Bids are removed from the other submitted Bids and not considered. Notice of submission of a replacement Bid or withdrawal of a Bid shall be worded so as not to reveal the amount of the original Bid.

§ 4.4.2 Withdrawn Bids may be resubmitted up to the date and time designated for the receipt of Bids in the same format as that established in Section 4.3, provided they fully conform with these Instructions to Bidders. Bid security shall be in an amount sufficient for the Bid as resubmitted.

§ 4.4.3 After the date and time designated for receipt of Bids, a Bidder who discovers that it made a clerical error in its Bid shall notify the Architect of such error within two days, or pursuant to a timeframe specified by the law of the jurisdiction where the Project is located, requesting withdrawal of its Bid. Upon providing evidence of such error to the reasonable satisfaction of the Architect, the Bid shall be withdrawn and not resubmitted. If a Bid is withdrawn pursuant to this Section 4.4.3, the bid security will be attended to as follows:

(State the terms and conditions, such as Bid rank, for returning or retaining the bid security.)

Per the instructions noted on website

ARTICLE 5 CONSIDERATION OF BIDS

§ 5.1 Opening of Bids

If stipulated in an advertisement or invitation to bid, or when otherwise required by law, Bids properly identified and received within the specified time limits will be publicly opened and read aloud. A summary of the Bids may be made available to Bidders.

§ 5.2 Rejection of Bids

Unless otherwise prohibited by law, the Owner shall have the right to reject any or all Bids.

§ 5.3 Acceptance of Bid (Award)

§ 5.3.1 It is the intent of the Owner to award a Contract to the lowest responsive and responsible Bidder, provided the Bid has been submitted in accordance with the requirements of the Bidding Documents. Unless otherwise prohibited by law, the Owner shall have the right to waive informalities and irregularities in a Bid received and to accept the Bid which, in the Owner's judgment, is in the Owner's best interests.

§ 5.3.2 Unless otherwise prohibited by law, the Owner shall have the right to accept Alternates in any order or combination, unless otherwise specifically provided in the Bidding Documents, and to determine the lowest responsive and responsible Bidder on the basis of the sum of the Base Bid and Alternates accepted.

ARTICLE 6 POST-BID INFORMATION

§ 6.1 Contractor's Qualification Statement

Bidders to whom award of a Contract is under consideration shall submit to the Architect, upon request and within the timeframe specified by the Architect, a properly executed AIA Document A305™, Contractor's Qualification Statement, unless such a Statement has been previously required and submitted for this Bid.

§ 6.2 Owner's Financial Capability

A Bidder to whom award of a Contract is under consideration may request in writing, fourteen days prior to the expiration of the time for withdrawal of Bids, that the Owner furnish to the Bidder reasonable evidence that financial arrangements have been made to fulfill the Owner's obligations under the Contract. The Owner shall then furnish such reasonable evidence to the Bidder no later than seven days prior to the expiration of the time for withdrawal of Bids. Unless such reasonable evidence is furnished within the allotted time, the Bidder will not be required to execute the Agreement between the Owner and Contractor.

§ 6.3 Submittals

§ 6.3.1 After notification of selection for the award of the Contract, the Bidder shall, as soon as practicable or as stipulated in the Bidding Documents, submit in writing to the Owner through the Architect:

- .1 a designation of the Work to be performed with the Bidder's own forces;
- .2 names of the principal products and systems proposed for the Work and the manufacturers and suppliers of each; and
- .3 names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for the principal portions of the Work.

§ 6.3.2 The Bidder will be required to establish to the satisfaction of the Architect and Owner the reliability and responsibility of the persons or entities proposed to furnish and perform the Work described in the Bidding Documents.

§ 6.3.3 Prior to the execution of the Contract, the Architect will notify the Bidder if either the Owner or Architect, after due investigation, has reasonable objection to a person or entity proposed by the Bidder. If the Owner or Architect has reasonable objection to a proposed person or entity, the Bidder may, at the Bidder's option, withdraw the Bid or submit an acceptable substitute person or entity. The Bidder may also submit any required adjustment in the Base Bid or Alternate Bid to account for the difference in cost occasioned by such substitution. The Owner may accept the adjusted bid price or disqualify the Bidder. In the event of either withdrawal or disqualification, bid security will not be forfeited.

§ 6.3.4 Persons and entities proposed by the Bidder and to whom the Owner and Architect have made no reasonable objection must be used on the Work for which they were proposed and shall not be changed except with the written consent of the Owner and Architect.

ARTICLE 7 PERFORMANCE BOND AND PAYMENT BOND

§ 7.1 Bond Requirements

§ 7.1.1 If stipulated in the Bidding Documents, the Bidder shall furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder.

§ 7.1.2 If the furnishing of such bonds is stipulated in the Bidding Documents, the cost shall be included in the Bid. If the furnishing of such bonds is required after receipt of bids and before execution of the Contract, the cost of such bonds shall be added to the Bid in determining the Contract Sum.

§ 7.1.3 The Bidder shall provide surety bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

§ 7.1.4 Unless otherwise indicated below, the Penal Sum of the Payment and Performance Bonds shall be the amount of the Contract Sum.

(If Payment or Performance Bonds are to be in an amount other than 100% of the Contract Sum, indicate the dollar amount or percentage of the Contract Sum.)

§ 7.2 Time of Delivery and Form of Bonds

§ 7.2.1 The Bidder shall deliver the required bonds to the Owner not later than three days following the date of execution of the Contract. If the Work is to commence sooner in response to a letter of intent, the Bidder shall, prior to commencement of the Work, submit evidence satisfactory to the Owner that such bonds will be furnished and delivered in accordance with this Section 7.2.1.

§ 7.2.2 Unless otherwise provided, the bonds shall be written on AIA Document A312, Performance Bond and Payment Bond.

§ 7.2.3 The bonds shall be dated on or after the date of the Contract.

§ 7.2.4 The Bidder shall require the attorney-in-fact who executes the required bonds on behalf of the surety to affix to the bond a certified and current copy of the power of attorney.

ARTICLE 8 ENUMERATION OF THE PROPOSED CONTRACT DOCUMENTS

§ 8.1 Copies of the proposed Contract Documents have been made available to the Bidder and consist of the following documents:

- .1 AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor, unless otherwise stated below.

(Paragraph deleted)

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

(Paragraph deleted)

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

(Paragraph deleted)

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

(Insert the date of the E203-2013.)

November 11, 2020

- .5 Drawings

Number	Title	Date
See Drawing Index in Architectural Drawings	Cover Sheet	November 11 th , 2020

- .6 Specifications

Section	Title	Date	Pages
See Specification Index in Project Manual	Project Manual Index	November 11, 2020	

.7 Addenda:

Number	Date	Pages
To Be Determined		

.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.)

The Sustainability Plan:

Title	Date	Pages

Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages

.9 Other documents listed below:

(List here any additional documents that are intended to form part of the Proposed Contract Documents.)

None

Additions and Deletions Report for AIA[®] Document A701[™] – 2018

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 14:04:07 MT on 11/18/2020.

PAGE 1

Layton City Fire Station 54
Layton, Utah
New Fire Station for Layton City per City RFP and Architects Proposal

...

Layton City, General Corporation
437 North Wasatch Drive
Layton, Utah 84041

...

Think Architecture, Inc., Subchapter S Corporation
7927 High Point Pkwy, Ste 300
Sandy, UT 84094
Telephone Number: (801) 269-0055
Fax Number: (801) 269-1425

PAGE 4

None
PAGE 5

Per the instructions noted on website
PAGE 7

(Insert the complete AIA Document number, including year, and Document title.)

...

- .2** AIA Document A101[™]–2017, Exhibit A, Insurance and Bonds, ~~unless otherwise stated below.~~ Bonds.
(Insert the complete AIA Document number, including year, and Document title.)

...

- .3** AIA Document A201[™]–2017, General Conditions of the Contract for ~~Construction,~~ Construction.
(Insert the complete AIA Document number, including year, and Document title.)

...

November 11, 2020

...

See Drawing Index in Architectural Cover Sheet
Drawings

November 11th, 2020

PAGE 8

See Specification Index in Project Project Manual Index
Manual

November 11,
2020

...

To Be Determined

...

None

Certification of Document's Authenticity

AIA® Document D401™ – 2003

I, Corey R. Solum, AIA, 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 14:04:07 MT on 11/18/2020 under Order No. 8184578310 from AIA Contract Documents software and that in preparing the attached final document I made no changes to the original text of AIA® Document A701™ – 2018, Instructions to Bidders, as published by the AIA in its software, other than those additions and deletions shown in the associated Additions and Deletions Report.

(Signed)

(Title)

(Dated)

SECTION 00 2213 - SUPPLEMENTARY INSTRUCTIONS TO BIDDERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. General Conditions of the contract for Construction.

B. Related Documents:

1. The Contract Documents, as defined in the General Conditions, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other documents.

PART 2 PRODUCTS (Not Used)

2.01 DOCUMENTS

- A. AIA Document A201 - 2017: General Conditions of the Contract for Construction.
 1. A copy of AIA Document A201 - 2017: General Conditions of the Contract for Construction" is bound in this Project Manual

PART 3 EXECUTION (Not Used)

END OF SECTION 00 2213

AIA[®] Document A201[®] – 2007

General Conditions of the Contract for Construction

for the following PROJECT:

(Name and location or address)

Layton City Fire Station 54

Layton, Utah

THE OWNER:

(Name, legal status and address)

Layton City, General Corporation

437 North Wasatch Drive

Layton, Utah 84041

THE ARCHITECT:

(Name, legal status and address)

Think Architecture, Inc., Subchapter S Corporation

7927 High Point Pkwy, Ste 300

Sandy, UT 84094

TABLE OF ARTICLES

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

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.

INDEX

(Topics and numbers in bold are section headings.)

Acceptance of Nonconforming Work

9.6.6, 9.9.3, **12.3**

Acceptance of Work

9.6.6, 9.8.2, 9.9.3, 9.10.1, 9.10.3, 12.3

Access to Work

3.16, 6.2.1, 12.1

Accident Prevention

10

Acts and Omissions

3.2, 3.3.2, 3.12.8, 3.18, 4.2.3, 8.3.1, 9.5.1, 10.2.5, 10.2.8, 13.4.2, 13.7, 14.1, 15.2

Addenda

1.1.1, 3.11

Additional Costs, Claims for

3.7.4, 3.7.5, 6.1.1, 7.3.7.5, 10.3, 15.1.4

Additional Inspections and Testing

9.4.2, 9.8.3, 12.2.1, **13.5**

Additional Insured

11.1.4

Additional Time, Claims for

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

Administration of the Contract

3.1.3, **4.2**, 9.4, 9.5

Advertisement or Invitation to Bid

1.1.1

Aesthetic Effect

4.2.13

Allowances

3.8, 7.3.8

All-risk Insurance

11.3.1, 11.3.1.1

Applications for Payment

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

Approvals

2.1.1, 2.2.2, 2.4, 3.1.3, 3.10.2, 3.12.8, 3.12.9, 3.12.10, 4.2.7, 9.3.2, 13.5.1

Arbitration

8.3.1, 11.3.10, 13.1, 15.3.2, **15.4**

ARCHITECT

4

Architect, Definition of

4.1.1

Architect, Extent of Authority

2.4, 3.12.7, 4.1, 4.2, 5.2, 6.3, 7.1.2, 7.3.7, 7.4, 9.2, 9.3.1, 9.4, 9.5, 9.6.3, 9.8, 9.10.1, 9.10.3, 12.1, 12.2.1, 13.5.1, 13.5.2, 14.2.2, 14.2.4, 15.1.3, 15.2.1

Architect, Limitations of Authority and Responsibility

2.1.1, 3.12.4, 3.12.8, 3.12.10, 4.1.2, 4.2.1, 4.2.2, 4.2.3, 4.2.6, 4.2.7, 4.2.10, 4.2.12, 4.2.13, 5.2.1, 7.4, 9.4.2, 9.5.3, 9.6.4, 15.1.3, 15.2

Architect's Additional Services and Expenses

2.4, 11.3.1.1, 12.2.1, 13.5.2, 13.5.3, 14.2.4

Architect's Administration of the Contract

3.1.3, 4.2, 3.7.4, 15.2, 9.4.1, 9.5

Architect's Approvals

2.4, 3.1.3, 3.5, 3.10.2, 4.2.7

Architect's Authority to Reject Work

3.5, 4.2.6, 12.1.2, 12.2.1

Architect's Copyright

1.1.7, 1.5

Architect's Decisions

3.7.4, 4.2.6, 4.2.7, 4.2.11, 4.2.12, 4.2.13, 4.2.14, 6.3, 7.3.7, 7.3.9, 8.1.3, 8.3.1, 9.2, 9.4.1, 9.5, 9.8.4, 9.9.1, 13.5.2, 15.2, 15.3

Architect's Inspections

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

Architect's Instructions

3.2.4, 3.3.1, 4.2.6, 4.2.7, 13.5.2

Architect's Interpretations

4.2.11, 4.2.12

Architect's Project Representative

4.2.10

Architect's Relationship with Contractor

1.1.2, 1.5, 3.1.3, 3.2.2, 3.2.3, 3.2.4, 3.3.1, 3.4.2, 3.5, 3.7.4, 3.7.5, 3.9.2, 3.9.3, 3.10, 3.11, 3.12, 3.16, 3.18, 4.1.2, 4.1.3, 4.2, 5.2, 6.2.2, 7, 8.3.1, 9.2, 9.3, 9.4, 9.5, 9.7, 9.8, 9.9, 10.2.6, 10.3, 11.3.7, 12, 13.4.2, 13.5, 15.2

Architect's Relationship with Subcontractors

1.1.2, 4.2.3, 4.2.4, 4.2.6, 9.6.3, 9.6.4, 11.3.7

Architect's Representations

9.4.2, 9.5.1, 9.10.1

Architect's Site Visits

3.7.4, 4.2.2, 4.2.9, 9.4.2, 9.5.1, 9.9.2, 9.10.1, 13.5

Asbestos

10.3.1

Attorneys' Fees

3.18.1, 9.10.2, 10.3.3

Award of Separate Contracts

6.1.1, 6.1.2

Award of Subcontracts and Other Contracts for Portions of the Work

5.2

Basic Definitions

1.1

Bidding Requirements

1.1.1, 5.2.1, 11.4.1

Binding Dispute Resolution

9.7, 11.3.9, 11.3.10, 13.1, 15.2.5, 15.2.6.1, 15.3.1, 15.3.2, 15.4.1

Boiler and Machinery Insurance

11.3.2

Bonds, Lien

7.3.7.4, 9.10.2, 9.10.3

Bonds, Performance, and Payment

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

Building Permit

3.7.1

Init.

Capitalization

1.3

Certificate of Substantial Completion

9.8.3, 9.8.4, 9.8.5

Certificates for Payment

4.2.1, 4.2.5, 4.2.9, 9.3.3, 9.4, 9.5, 9.6.1, 9.6.6, 9.7, 9.10.1, 9.10.3, 14.1.1.3, 14.2.4, 15.1.3

Certificates of Inspection, Testing or Approval
13.5.4

Certificates of Insurance

9.10.2, 11.1.3

Change Orders

1.1.1, 2.4, 3.4.2, 3.7.4, 3.8.2.3, 3.11, 3.12.8, 4.2.8, 5.2.3, 7.1.2, 7.1.3, 7.2, 7.3.2, 7.3.6, 7.3.9, 7.3.10, 8.3.1, 9.3.1.1, 9.10.3, 10.3.2, 11.3.1.2, 11.3.4, 11.3.9, 12.1.2, 15.1.3

Change Orders, Definition of

7.2.1

CHANGES IN THE WORK

2.2.1, 3.11, 4.2.8, 7, 7.2.1, 7.3.1, 7.4, 8.3.1, 9.3.1.1, 11.3.9

Claims, Definition of

15.1.1

CLAIMS AND DISPUTES

3.2.4, 6.1.1, 6.3, 7.3.9, 9.3.3, 9.10.4, 10.3.3, 15, 15.4

Claims and Timely Assertion of Claims

15.4.1

Claims for Additional Cost

3.2.4, 3.7.4, 6.1.1, 7.3.9, 10.3.2, 15.1.4

Claims for Additional Time

3.2.4, 3.7.4, 6.1.1, 8.3.2, 10.3.2, 15.1.5

Concealed or Unknown Conditions, Claims for

3.7.4

Claims for Damages

3.2.4, 3.18, 6.1.1, 8.3.3, 9.5.1, 9.6.7, 10.3.3, 11.1.1, 11.3.5, 11.3.7, 14.1.3, 14.2.4, 15.1.6

Claims Subject to Arbitration

15.3.1, 15.4.1

Cleaning Up

3.15, 6.3

Commencement of the Work, Conditions Relating to

2.2.1, 3.2.2, 3.4.1, 3.7.1, 3.10.1, 3.12.6, 5.2.1, 5.2.3, 6.2.2, 8.1.2, 8.2.2, 8.3.1, 11.1, 11.3.1, 11.3.6, 11.4.1, 15.1.4

Commencement of the Work, Definition of

8.1.2

Communications Facilitating Contract

Administration

3.9.1, 4.2.4

Completion, Conditions Relating to

3.4.1, 3.11, 3.15, 4.2.2, 4.2.9, 8.2, 9.4.2, 9.8, 9.9.1, 9.10, 12.2, 13.7, 14.1.2

COMPLETION, PAYMENTS AND

9

Completion, Substantial

4.2.9, 8.1.1, 8.1.3, 8.2.3, 9.4.2, 9.8, 9.9.1, 9.10.3, 12.2, 13.7

Compliance with Laws

1.6, 3.2.3, 3.6, 3.7, 3.12.10, 3.13, 4.1.1, 9.6.4, 10.2.2, 11.1, 11.3, 13.1, 13.4, 13.5.1, 13.5.2, 13.6, 14.1.1, 14.2.1.3, 15.2.8, 15.4.2, 15.4.3

Concealed or Unknown Conditions

3.7.4, 4.2.8, 8.3.1, 10.3

Conditions of the Contract

1.1.1, 6.1.1, 6.1.4

Consent, Written

3.4.2, 3.7.4, 3.12.8, 3.14.2, 4.1.2, 9.3.2, 9.8.5, 9.9.1, 9.10.2, 9.10.3, 11.3.1, 13.2, 13.4.2, 15.4.4.2

Consolidation or Joinder

15.4.4

CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

1.1.4, 6

Construction Change Directive, Definition of
7.3.1

Construction Change Directives

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

Construction Schedules, Contractor's

3.10, 3.12.1, 3.12.2, 6.1.3, 15.1.5.2

Contingent Assignment of Subcontracts

5.4, 14.2.2.2

Continuing Contract Performance

15.1.3

Contract, Definition of

1.1.2

CONTRACT, TERMINATION OR SUSPENSION OF THE

5.4.1.1, 11.3.9, 14

Contract Administration

3.1.3, 4, 9.4, 9.5

Contract Award and Execution, Conditions Relating to

3.7.1, 3.10, 5.2, 6.1, 11.1.3, 11.3.6, 11.4.1

Contract Documents, Copies Furnished and Use of
1.5.2, 2.2.5, 5.3

Contract Documents, Definition of

1.1.1

Contract Sum

3.7.4, 3.8, 5.2.3, 7.2, 7.3, 7.4, 9.1, 9.4.2, 9.5.1.4, 9.6.7, 9.7, 10.3.2, 11.3.1, 14.2.4, 14.3.2, 15.1.4, 15.2.5

Contract Sum, Definition of

9.1

Contract Time

3.7.4, 3.7.5, 3.10.2, 5.2.3, 7.2.1.3, 7.3.1, 7.3.5, 7.4, 8.1.1, 8.2.1, 8.3.1, 9.5.1, 9.7, 10.3.2, 12.1.1, 14.3.2, 15.1.5.1, 15.2.5

Contract Time, Definition of

8.1.1

CONTRACTOR

3

Contractor, Definition of

3.1, 6.1.2

Contractor's Construction Schedules

3.10, 3.12.1, 3.12.2, 6.1.3, 15.1.5.2

Contractor's Employees

3.3.2, 3.4.3, 3.8.1, 3.9, 3.18.2, 4.2.3, 4.2.6, 10.2, 10.3, 11.1.1, 11.3.7, 14.1, 14.2.1.1

Contractor's Liability Insurance

11.1

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

3.12.5, 3.14.2, 4.2.4, 6, 11.3.7, 12.1.2, 12.2.4

Contractor's Relationship with Subcontractors

1.2.2, 3.3.2, 3.18.1, 3.18.2, 5, 9.6.2, 9.6.7, 9.10.2, 11.3.1.2, 11.3.7, 11.3.8

Contractor's Relationship with the Architect

1.1.2, 1.5, 3.1.3, 3.2.2, 3.2.3, 3.2.4, 3.3.1, 3.4.2, 3.5, 3.7.4, 3.10, 3.11, 3.12, 3.16, 3.18, 4.1.3, 4.2, 5.2, 6.2.2, 7, 8.3.1, 9.2, 9.3, 9.4, 9.5, 9.7, 9.8, 9.9, 10.2.6, 10.3, 11.3.7, 12, 13.5, 15.1.2, 15.2.1

Contractor's Representations

3.2.1, 3.2.2, 3.5, 3.12.6, 6.2.2, 8.2.1, 9.3.3, 9.8.2

Contractor's Responsibility for Those Performing the Work

3.3.2, 3.18, 5.3, 6.1.3, 6.2, 9.5.1, 10.2.8

Contractor's Review of Contract Documents

3.2

Contractor's Right to Stop the Work

9.7

Contractor's Right to Terminate the Contract

14.1, 15.1.6

Contractor's Submittals

3.10, 3.11, 3.12.4, 4.2.7, 5.2.1, 5.2.3, 9.2, 9.3, 9.8.2, 9.8.3, 9.9.1, 9.10.2, 9.10.3, 11.1.3, 11.4.2

Contractor's Superintendent

3.9, 10.2.6

Contractor's Supervision and Construction

Procedures

1.2.2, 3.3, 3.4, 3.12.10, 4.2.2, 4.2.7, 6.1.3, 6.2.4, 7.1.3, 7.3.5, 7.3.7, 8.2, 10, 12, 14, 15.1.3

Contractual Liability Insurance

11.1.1.8, 11.2

Coordination and Correlation

1.2, 3.2.1, 3.3.1, 3.10, 3.12.6, 6.1.3, 6.2.1

Copies Furnished of Drawings and Specifications

1.5, 2.2.5, 3.11

Copyrights

1.5, 3.17

Correction of Work

2.3, 2.4, 3.7.3, 9.4.2, 9.8.2, 9.8.3, 9.9.1, 12.1.2, 12.2

Correlation and Intent of the Contract Documents

1.2

Cost, Definition of

7.3.7

Costs

2.4, 3.2.4, 3.7.3, 3.8.2, 3.15.2, 5.4.2, 6.1.1, 6.2.3, 7.3.3.3, 7.3.7, 7.3.8, 7.3.9, 9.10.2, 10.3.2, 10.3.6, 11.3, 12.1.2, 12.2.1, 12.2.4, 13.5, 14

Cutting and Patching

3.14, 6.2.5

Damage to Construction of Owner or Separate Contractors

3.14.2, 6.2.4, 10.2.1.2, 10.2.5, 10.4, 11.1.1, 11.3, 12.2.4

Damage to the Work

3.14.2, 9.9.1, 10.2.1.2, 10.2.5, 10.4, 11.3.1, 12.2.4

Damages, Claims for

3.2.4, 3.18, 6.1.1, 8.3.3, 9.5.1, 9.6.7, 10.3.3, 11.1.1, 11.3.5, 11.3.7, 14.1.3, 14.2.4, 15.1.6

Damages for Delay

6.1.1, 8.3.3, 9.5.1.6, 9.7, 10.3.2

Date of Commencement of the Work, Definition of

8.1.2

Date of Substantial Completion, Definition of

8.1.3

Day, Definition of

8.1.4

Decisions of the Architect

3.7.4, 4.2.6, 4.2.7, 4.2.11, 4.2.12, 4.2.13, 15.2, 6.3, 7.3.7, 7.3.9, 8.1.3, 8.3.1, 9.2, 9.4, 9.5.1, 9.8.4, 9.9.1, 13.5.2, 14.2.2, 14.2.4, 15.1, 15.2

Decisions to Withhold Certification

9.4.1, 9.5, 9.7, 14.1.1.3

Defective or Nonconforming Work, Acceptance, Rejection and Correction of

2.3, 2.4, 3.5, 4.2.6, 6.2.5, 9.5.1, 9.5.2, 9.6.6, 9.8.2, 9.9.3, 9.10.4, 12.2.1

Definitions

1.1, 2.1.1, 3.1.1, 3.5, 3.12.1, 3.12.2, 3.12.3, 4.1.1, 15.1.1, 5.1, 6.1.2, 7.2.1, 7.3.1, 8.1, 9.1, 9.8.1

Delays and Extensions of Time

3.2, 3.7.4, 5.2.3, 7.2.1, 7.3.1, 7.4, 8.3, 9.5.1, 9.7, 10.3.2, 10.4, 14.3.2, 15.1.5, 15.2.5

Disputes

6.3, 7.3.9, 15.1, 15.2

Documents and Samples at the Site

3.11

Drawings, Definition of

1.1.5

Drawings and Specifications, Use and Ownership of

3.11

Effective Date of Insurance

8.2.2, 11.1.2

Emergencies

10.4, 14.1.1.2, 15.1.4

Employees, Contractor's

3.3.2, 3.4.3, 3.8.1, 3.9, 3.18.2, 4.2.3, 4.2.6, 10.2, 10.3.3, 11.1.1, 11.3.7, 14.1, 14.2.1.1

Equipment, Labor, Materials or

1.1.3, 1.1.6, 3.4, 3.5, 3.8.2, 3.8.3, 3.12, 3.13, 3.15.1, 4.2.6, 4.2.7, 5.2.1, 6.2.1, 7.3.7, 9.3.2, 9.3.3, 9.5.1.3, 9.10.2, 10.2.1, 10.2.4, 14.2.1.1, 14.2.1.2

Execution and Progress of the Work
1.1.3, 1.2.1, 1.2.2, 2.2.3, 2.2.5, 3.1, 3.3.1, 3.4.1, 3.5,
3.7.1, 3.10.1, 3.12, 3.14, 4.2, 6.2.2, 7.1.3, 7.3.5, 8.2,
9.5.1, 9.9.1, 10.2, 10.3, 12.2, 14.2, 14.3.1, 15.1.3
Extensions of Time
3.2.4, 3.7.4, 5.2.3, 7.2.1, 7.3, 7.4, 9.5.1, 9.7, 10.3.2,
10.4, 14.3, 15.1.5, 15.2.5
Failure of Payment
9.5.1.3, 9.7, 9.10.2, 13.6, 14.1.1.3, 14.2.1.2
Faulty Work
(See Defective or Nonconforming Work)
Final Completion and Final Payment
4.2.1, 4.2.9, 9.8.2, 9.10, 11.1.2, 11.1.3, 11.3.1, 11.3.5,
12.3, 14.2.4, 14.4.3
Financial Arrangements, Owner's
2.2.1, 13.2.2, 14.1.1.4
Fire and Extended Coverage Insurance
11.3.1.1

GENERAL PROVISIONS

1

Governing Law

13.1

Guarantees (See Warranty)

Hazardous Materials

10.2.4, 10.3

Identification of Subcontractors and Suppliers
5.2.1

Indemnification

3.17, 3.18, 9.10.2, 10.3.3, 10.3.5, 10.3.6, 11.3.1.2,
11.3.7

Information and Services Required of the Owner

2.1.2, 2.2, 3.2.2, 3.12.4, 3.12.10, 6.1.3, 6.1.4, 6.2.5,
9.6.1, 9.6.4, 9.9.2, 9.10.3, 10.3.3, 11.2, 11.4, 13.5.1,
13.5.2, 14.1.1.4, 14.1.4, 15.1.3

Initial Decision

15.2

Initial Decision Maker, Definition of

1.1.8

Initial Decision Maker, Decisions

14.2.2, 14.2.4, 15.2.1, 15.2.2, 15.2.3, 15.2.4, 15.2.5

Initial Decision Maker, Extent of Authority

14.2.2, 14.2.4, 15.1.3, 15.2.1, 15.2.2, 15.2.3, 15.2.4,
15.2.5

Injury or Damage to Person or Property

10.2.8, 10.4

Inspections

3.1.3, 3.3.3, 3.7.1, 4.2.2, 4.2.6, 4.2.9, 9.4.2, 9.8.3,
9.9.2, 9.10.1, 12.2.1, 13.5

Instructions to Bidders

1.1.1

Instructions to the Contractor

3.2.4, 3.3.1, 3.8.1, 5.2.1, 7, 8.2.2, 12, 13.5.2

Instruments of Service, Definition of

1.1.7

Insurance

3.18.1, 6.1.1, 7.3.7, 9.3.2, 9.8.4, 9.9.1, 9.10.2, 11

Insurance, Boiler and Machinery

11.3.2

Insurance, Contractor's Liability

11.1

Insurance, Effective Date of

8.2.2, 11.1.2

Insurance, Loss of Use

11.3.3

Insurance, Owner's Liability

11.2

Insurance, Property

10.2.5, 11.3

Insurance, Stored Materials

9.3.2

INSURANCE AND BONDS

11

Insurance Companies, Consent to Partial Occupancy
9.9.1

Intent of the Contract Documents

1.2.1, 4.2.7, 4.2.12, 4.2.13, 7.4

Interest

13.6

Interpretation

1.2.3, 1.4, 4.1.1, 5.1, 6.1.2, 15.1.1

Interpretations, Written

4.2.11, 4.2.12, 15.1.4

Judgment on Final Award

15.4.2

Labor and Materials, Equipment

1.1.3, 1.1.6, 3.4, 3.5, 3.8.2, 3.8.3, 3.12, 3.13, 3.15.1,
4.2.6, 4.2.7, 5.2.1, 6.2.1, 7.3.7, 9.3.2, 9.3.3, 9.5.1.3,
9.10.2, 10.2.1, 10.2.4, 14.2.1.1, 14.2.1.2

Labor Disputes

8.3.1

Laws and Regulations

1.5, 3.2.3, 3.6, 3.7, 3.12.10, 3.13, 4.1.1, 9.6.4, 9.9.1,
10.2.2, 11.1.1, 11.3, 13.1, 13.4, 13.5.1, 13.5.2, 13.6,
14, 15.2.8, 15.4

Liens

2.1.2, 9.3.3, 9.10.2, 9.10.4, 15.2.8

Limitations, Statutes of

12.2.5, 13.7, 15.4.1.1

Limitations of Liability

2.3, 3.2.2, 3.5, 3.12.10, 3.17, 3.18.1, 4.2.6, 4.2.7,
4.2.12, 6.2.2, 9.4.2, 9.6.4, 9.6.7, 10.2.5, 10.3.3, 11.1.2,
11.2, 11.3.7, 12.2.5, 13.4.2

Limitations of Time

2.1.2, 2.2, 2.4, 3.2.2, 3.10, 3.11, 3.12.5, 3.15.1, 4.2.7,
5.2, 5.3, 5.4.1, 6.2.4, 7.3, 7.4, 8.2, 9.2, 9.3.1, 9.3.3,
9.4.1, 9.5, 9.6, 9.7, 9.8, 9.9, 9.10, 11.1.3, 11.3.1.5,
11.3.6, 11.3.10, 12.2, 13.5, 13.7, 14, 15

Loss of Use Insurance

11.3.3

Material Suppliers

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

Materials, Hazardous

10.2.4, 10.3

Init.

/

Materials, Labor, Equipment and
 1.1.3, 1.1.6, 1.5.1, 3.4.1, 3.5, 3.8.2, 3.8.3, 3.12, 3.13,
 3.15.1, 4.2.6, 4.2.7, 5.2.1, 6.2.1, 7.3.7, 9.3.2, 9.3.3,
 9.5.1.3, 9.10.2, 10.2.1.2, 10.2.4, 14.2.1.1, 14.2.1.2
 Means, Methods, Techniques, Sequences and
 Procedures of Construction
 3.3.1, 3.12.10, 4.2.2, 4.2.7, 9.4.2
 Mechanic's Lien
 2.1.2, 15.2.8
Mediation
 8.3.1, 10.3.5, 10.3.6, 15.2.1, 15.2.5, 15.2.6, **15.3**,
 15.4.1
Minor Changes in the Work
 1.1.1, 3.12.8, 4.2.8, 7.1, **7.4**
MISCELLANEOUS PROVISIONS
13
Modifications, Definition of
1.1.1
 Modifications to the Contract
 1.1.1, 1.1.2, 3.11, 4.1.2, 4.2.1, 5.2.3, 7, 8.3.1, 9.7,
 10.3.2, 11.3.1
Mutual Responsibility
6.2
Nonconforming Work, Acceptance of
 9.6.6, 9.9.3, **12.3**
 Nonconforming Work, Rejection and Correction of
 2.3, 2.4, 3.5, 4.2.6, 6.2.4, 9.5.1, 9.8.2, 9.9.3, 9.10.4,
 12.2.1
 Notice
 2.2.1, 2.3, 2.4, 3.2.4, 3.3.1, 3.7.2, 3.12.9, 5.2.1, 9.7,
 9.10, 10.2.2, 11.1.3, 12.2.2.1, 13.3, 13.5.1, 13.5.2,
 14.1, 14.2, 15.2.8, 15.4.1
Notice, Written
 2.3, 2.4, 3.3.1, 3.9.2, 3.12.9, 3.12.10, 5.2.1, 9.7, 9.10,
 10.2.2, 10.3, 11.1.3, 11.3.6, 12.2.2.1, **13.3**, 14, 15.2.8,
 15.4.1
Notice of Claims
 3.7.4, 10.2.8, **15.1.2**, 15.4
 Notice of Testing and Inspections
 13.5.1, 13.5.2
 Observations, Contractor's
 3.2, 3.7.4
 Occupancy
 2.2.2, 9.6.6, 9.8, 11.3.1.5
 Orders, Written
 1.1.1, 2.3, 3.9.2, 7, 8.2.2, 11.3.9, 12.1, 12.2.2.1, 13.5.2,
 14.3.1
OWNER
2
Owner, Definition of
2.1.1
Owner, Information and Services Required of the
 2.1.2, **2.2**, 3.2.2, 3.12.10, 6.1.3, 6.1.4, 6.2.5, 9.3.2,
 9.6.1, 9.6.4, 9.9.2, 9.10.3, 10.3.3, 11.2, 11.3, 13.5.1,
 13.5.2, 14.1.1.4, 14.1.4, 15.1.3

Owner's Authority
 1.5, 2.1.1, 2.3, 2.4, 3.4.2, 3.8.1, 3.12.10, 3.14.2, 4.1.2,
 4.1.3, 4.2.4, 4.2.9, 5.2.1, 5.2.4, 5.4.1, 6.1, 6.3, 7.2.1,
 7.3.1, 8.2.2, 8.3.1, 9.3.1, 9.3.2, 9.5.1, 9.6.4, 9.9.1,
 9.10.2, 10.3.2, 11.1.3, 11.3.3, 11.3.10, 12.2.2, 12.3,
 13.2.2, 14.3, 14.4, 15.2.7
 Owner's Financial Capability
 2.2.1, 13.2.2, 14.1.1.4
Owner's Liability Insurance
11.2
 Owner's Relationship with Subcontractors
 1.1.2, 5.2, 5.3, 5.4, 9.6.4, 9.10.2, 14.2.2
Owner's Right to Carry Out the Work
2.4, 14.2.2
Owner's Right to Clean Up
6.3
Owner's Right to Perform Construction and to
Award Separate Contracts
6.1
Owner's Right to Stop the Work
2.3
 Owner's Right to Suspend the Work
 14.3
 Owner's Right to Terminate the Contract
 14.2
Ownership and Use of Drawings, Specifications
and Other Instruments of Service
 1.1.1, 1.1.6, 1.1.7, **1.5**, 2.2.5, 3.2.2, 3.11, 3.17, 4.2.12,
 5.3
Partial Occupancy or Use
 9.6.6, **9.9**, 11.3.1.5
Patching, Cutting and
3.14, 6.2.5
 Patents
 3.17
Payment, Applications for
 4.2.5, 7.3.9, 9.2, **9.3**, 9.4, 9.5, 9.6.3, 9.7, 9.8.5, 9.10.1,
 14.2.3, 14.2.4, 14.4.3
Payment, Certificates for
 4.2.5, 4.2.9, 9.3.3, **9.4**, 9.5, 9.6.1, 9.6.6, 9.7, 9.10.1,
 9.10.3, 13.7, 14.1.1.3, 14.2.4
Payment, Failure of
 9.5.1.3, **9.7**, 9.10.2, 13.6, 14.1.1.3, 14.2.1.2
 Payment, Final
 4.2.1, 4.2.9, 9.8.2, 9.10, 11.1.2, 11.1.3, 11.4.1, 12.3,
 13.7, 14.2.4, 14.4.3
Payment Bond, Performance Bond and
7.3.7.4, 9.6.7, 9.10.3, **11.4**
Payments, Progress
 9.3, **9.6**, 9.8.5, 9.10.3, 13.6, 14.2.3, 15.1.3
PAYMENTS AND COMPLETION
9
 Payments to Subcontractors
 5.4.2, 9.5.1.3, 9.6.2, 9.6.3, 9.6.4, 9.6.7, 14.2.1.2
 PCB
 10.3.1

Performance Bond and Payment Bond
7.3.7.4, 9.6.7, 9.10.3, 11.4

Permits, Fees, Notices and Compliance with Laws
2.2.2, 3.7, 3.13, 7.3.7.4, 10.2.2

PERSONS AND PROPERTY, PROTECTION OF
10

Polychlorinated Biphenyl
10.3.1

Product Data, Definition of
3.12.2

Product Data and Samples, Shop Drawings
3.11, 3.12, 4.2.7

Progress and Completion
4.2.2, 8.2, 9.8, 9.9.1, 14.1.4, 15.1.3

Progress Payments
9.3, 9.6, 9.8.5, 9.10.3, 13.6, 14.2.3, 15.1.3

Project, Definition of
1.1.4

Project Representatives
4.2.10

Property Insurance
10.2.5, 11.3

PROTECTION OF PERSONS AND PROPERTY
10

Regulations and Laws
1.5, 3.2.3, 3.6, 3.7, 3.12.10, 3.13, 4.1.1, 9.6.4, 9.9.1,
10.2.2, 11.1, 11.4, 13.1, 13.4, 13.5.1, 13.5.2, 13.6, 14,
15.2.8, 15.4

Rejection of Work
3.5, 4.2.6, 12.2.1

Releases and Waivers of Liens
9.10.2

Representations
3.2.1, 3.5, 3.12.6, 6.2.2, 8.2.1, 9.3.3, 9.4.2, 9.5.1, 9.8.2,
9.10.1

Representatives
2.1.1, 3.1.1, 3.9, 4.1.1, 4.2.1, 4.2.2, 4.2.10, 5.1.1, 5.1.2,
13.2.1

Responsibility for Those Performing the Work
3.3.2, 3.18, 4.2.3, 5.3, 6.1.3, 6.2, 6.3, 9.5.1, 10

Retainage
9.3.1, 9.6.2, 9.8.5, 9.9.1, 9.10.2, 9.10.3

Review of Contract Documents and Field
Conditions by Contractor
3.2, 3.12.7, 6.1.3

Review of Contractor's Submittals by Owner and
Architect
3.10.1, 3.10.2, 3.11, 3.12, 4.2, 5.2, 6.1.3, 9.2, 9.8.2

Review of Shop Drawings, Product Data and Samples
by Contractor
3.12

Rights and Remedies
1.1.2, 2.3, 2.4, 3.5, 3.7.4, 3.15.2, 4.2.6, 5.3, 5.4, 6.1,
6.3, 7.3.1, 8.3, 9.5.1, 9.7, 10.2.5, 10.3, 12.2.2, 12.2.4,
13.4, 14, 15.4

Royalties, Patents and Copyrights
3.17

Rules and Notices for Arbitration
15.4.1

Safety of Persons and Property
10.2, 10.4

Safety Precautions and Programs
3.3.1, 4.2.2, 4.2.7, 5.3, 10.1, 10.2, 10.4

Samples, Definition of
3.12.3

Samples, Shop Drawings, Product Data and
3.11, 3.12, 4.2.7

Samples at the Site, Documents and
3.11

Schedule of Values
9.2, 9.3.1

Schedules, Construction
3.10, 3.12.1, 3.12.2, 6.1.3, 15.1.5.2

Separate Contracts and Contractors
1.1.4, 3.12.5, 3.14.2, 4.2.4, 4.2.7, 6, 8.3.1, 12.1.2

Shop Drawings, Definition of
3.12.1

Shop Drawings, Product Data and Samples
3.11, 3.12, 4.2.7

Site, Use of
3.13, 6.1.1, 6.2.1

Site Inspections
3.2.2, 3.3.3, 3.7.1, 3.7.4, 4.2, 9.4.2, 9.10.1, 13.5

Site Visits, Architect's
3.7.4, 4.2.2, 4.2.9, 9.4.2, 9.5.1, 9.9.2, 9.10.1, 13.5

Special Inspections and Testing
4.2.6, 12.2.1, 13.5

Specifications, Definition of
1.1.6

Specifications
1.1.1, 1.1.6, 1.2.2, 1.5, 3.11, 3.12.10, 3.17, 4.2.14

Statute of Limitations
13.7, 15.4.1.1

Stopping the Work
2.3, 9.7, 10.3, 14.1

Stored Materials
6.2.1, 9.3.2, 10.2.1.2, 10.2.4

Subcontractor, Definition of
5.1.1

SUBCONTRACTORS
5

Subcontractors, Work by
1.2.2, 3.3.2, 3.12.1, 4.2.3, 5.2.3, 5.3, 5.4, 9.3.1.2, 9.6.7

Subcontractual Relations
5.3, 5.4, 9.3.1.2, 9.6, 9.10, 10.2.1, 14.1, 14.2.1

Submittals
3.10, 3.11, 3.12, 4.2.7, 5.2.1, 5.2.3, 7.3.7, 9.2, 9.3, 9.8,
9.9.1, 9.10.2, 9.10.3, 11.1.3

Submittal Schedule
3.10.2, 3.12.5, 4.2.7

Subrogation, Waivers of
6.1.1, 11.3.7

Substantial Completion

4.2.9, 8.1.1, 8.1.3, 8.2.3, 9.4.2, **9.8**, 9.9.1, 9.10.3, 12.2, 13.7

Substantial Completion, Definition of 9.8.1

Substitution of Subcontractors
5.2.3, 5.2.4

Substitution of Architect
4.1.3

Substitutions of Materials
3.4.2, 3.5, 7.3.8

Sub-subcontractor, Definition of 5.1.2

Subsurface Conditions
3.7.4

Successors and Assigns 13.2

Superintendent 3.9, 10.2.6

Supervision and Construction Procedures

1.2.2, **3.3**, 3.4, 3.12.10, 4.2.2, 4.2.7, 6.1.3, 6.2.4, 7.1.3, 7.3.7, 8.2, 8.3.1, 9.4.2, 10, 12, 14, 15.1.3

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

Surety, Consent of
9.10.2, 9.10.3

Surveys
2.2.3

Suspension by the Owner for Convenience 14.3

Suspension of the Work
5.4.2, 14.3

Suspension or Termination of the Contract
5.4.1.1, 14

Taxes
3.6, 3.8.2.1, 7.3.7.4

Termination by the Contractor 14.1, 15.1.6

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

Termination by the Owner for Convenience 14.4

Termination of the Architect
4.1.3

Termination of the Contractor
14.2.2

TERMINATION OR SUSPENSION OF THE CONTRACT 14

Tests and Inspections

3.1.3, 3.3.3, 4.2.2, 4.2.6, 4.2.9, 9.4.2, 9.8.3, 9.9.2, 9.10.1, 10.3.2, 11.4.1, 12.2.1, **13.5**

TIME 8

Time, Delays and Extensions of

3.2.4, 3.7.4, 5.2.3, 7.2.1, 7.3.1, 7.4, **8.3**, 9.5.1, 9.7, 10.3.2, 10.4, 14.3.2, 15.1.5, 15.2.5

Time Limits

2.1.2, 2.2, 2.4, 3.2.2, 3.10, 3.11, 3.12.5, 3.15.1, 4.2, 5.2, 5.3, 5.4, 6.2.4, 7.3, 7.4, 8.2, 9.2, 9.3.1, 9.3.3, 9.4.1, 9.5, 9.6, 9.7, 9.8, 9.9, 9.10, 11.1.3, 12.2, 13.5, 13.7, 14, 15.1.2, 15.4

Time Limits on Claims

3.7.4, 10.2.8, **13.7**, 15.1.2

Title to Work
9.3.2, 9.3.3

Transmission of Data in Digital Form 1.6

UNCOVERING AND CORRECTION OF WORK 12

Uncovering of Work 12.1

Unforeseen Conditions, Concealed or Unknown
3.7.4, 8.3.1, 10.3

Unit Prices
7.3.3.2, 7.3.4

Use of Documents
1.1.1, 1.5, 2.2.5, 3.12.6, 5.3

Use of Site 3.13, 6.1.1, 6.2.1

Values, Schedule of 9.2, 9.3.1

Waiver of Claims by the Architect
13.4.2

Waiver of Claims by the Contractor
9.10.5, 13.4.2, 15.1.6

Waiver of Claims by the Owner
9.9.3, 9.10.3, 9.10.4, 12.2.2.1, 13.4.2, 14.2.4, 15.1.6

Waiver of Consequential Damages
14.2.4, 15.1.6

Waiver of Liens
9.10.2, 9.10.4

Waivers of Subrogation 6.1.1, 11.3.7

Warranty
3.5, 4.2.9, 9.3.3, 9.8.4, 9.9.1, 9.10.4, 12.2.2, 13.7

Weather Delays
15.1.5.2

Work, Definition of 1.1.3

Written Consent
1.5.2, 3.4.2, 3.7.4, 3.12.8, 3.14.2, 4.1.2, 9.3.2, 9.8.5, 9.9.1, 9.10.2, 9.10.3, 11.4.1, 13.2, 13.4.2, 15.4.4.2

Written Interpretations
4.2.11, 4.2.12

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

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

ARTICLE 1 GENERAL PROVISIONS

§ 1.1 BASIC DEFINITIONS

§ 1.1.1 THE CONTRACT DOCUMENTS

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (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 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 and certify termination of the Agreement under Section 14.2.2.

§ 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.

§ 1.2.2 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 will retain all common law, statutory and other reserved rights, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and material or equipment 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 this 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 material or equipment suppliers are authorized to use and reproduce the Instruments of Service provided to them 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 material or equipment suppliers may not use the Instruments of Service on other projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner, Architect and the Architect's consultants.

§ 1.6 TRANSMISSION OF DATA IN DIGITAL FORM

If the parties intend to transmit Instruments of Service or any other information or documentation in digital form, they shall endeavor to establish necessary protocols governing such transmissions, unless otherwise already provided in the Agreement or the Contract Documents.

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 INFORMATION AND SERVICES REQUIRED OF THE OWNER

§ 2.2.1 Prior to commencement of the Work, the Contractor may request in writing that the Owner provide reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. Thereafter, the Contractor may only request such evidence if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) a change in the Work materially changes the Contract Sum; or (3) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due. The Owner shall furnish such evidence as a condition precedent to commencement or continuation of the Work or the

portion of the Work affected by a material change. After the Owner furnishes the evidence, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

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

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

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

§ 2.2.5 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.

§ 2.3 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.

§ 2.4 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 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 reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect or failure. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

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 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 2.2.3, 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 make 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 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, unless the Contract Documents give other specific instructions concerning these matters. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences or procedures, the Contractor shall evaluate the jobsite safety thereof and, except as stated below, shall be fully and solely responsible for the jobsite safety of such means, methods, techniques, sequences or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely written notice to the Owner and Architect and shall not proceed with that portion of the Work without further written instructions from the Architect. If the Contractor is then instructed to proceed with the required means, methods, techniques, sequences or procedures without acceptance of changes proposed by the Contractor, the Owner shall be solely responsible for any loss or damage arising solely from those Owner-required means, methods, techniques, sequences or procedures.

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

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

§ 3.4 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 authorized by the Architect in accordance with Sections 3.12.8 or 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

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.

§ 3.6 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 21 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 an equitable adjustment in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor in writing, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may proceed 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 furnish in writing to the Owner through the Architect the name and qualifications of a proposed superintendent. The Architect may reply within 14 days to the Contractor in writing stating (1) whether the Owner or the Architect has reasonable objection to the proposed superintendent or (2) that the Architect requires additional time to review. Failure of the Architect to reply 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 SCHEDULES

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

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

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

§ 3.11 DOCUMENTS AND SAMPLES AT THE SITE

The Contractor shall maintain at the site for the Owner one copy of the Drawings, Specifications, Addenda, Change Orders and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and one copy of approved Shop Drawings, Product Data, Samples and similar required

submittals. These shall be available to the Architect and shall be delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.12 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

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

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

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

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

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

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so 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 requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Architect in writing of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Architect's approval thereof.

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

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. The Contractor shall not be required to provide professional services in violation of applicable law. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall cause such services or certifications to be provided by a properly licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop

Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor all performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review, approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Contractor shall not be responsible for the adequacy of the performance and design criteria specified in the Contract Documents.

§ 3.13 USE OF SITE

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

§ 3.14 CUTTING AND PATCHING

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

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

§ 3.15 CLEANING UP

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

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

§ 3.16 ACCESS TO WORK

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

§ 3.17 ROYALTIES, PATENTS AND COPYRIGHTS

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

§ 3.18 INDEMNIFICATION

§ 3.18.1 To the fullest extent permitted by law 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 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.

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

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

§ 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, except as provided in Section 3.3.1.

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

§ 4.2.4 COMMUNICATIONS FACILITATING CONTRACT ADMINISTRATION

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

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

§ 4.2.6 The Architect has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the Work in accordance with Sections 13.5.2 and 13.5.3, whether or not such Work is fabricated, installed or completed.

However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, material and equipment suppliers, their agents or employees, or other persons or entities performing portions of the Work.

§ 4.2.7 The Architect will review 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, unless otherwise specifically stated by the Architect, of any construction means, methods, techniques, sequences or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.8 The Architect will prepare Change Orders and Construction Change Directives, and may authorize 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 duties, responsibilities and limitations of authority of such project representatives shall be as set forth in an exhibit to be incorporated in the Contract Documents.

§ 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 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 or the bidding requirements, the Contractor, as soon as practicable after award of the Contract, shall furnish in writing to the Owner through the Architect the names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each principal portion of the Work. The Architect may reply within 14 days to the Contractor in writing stating (1) whether the Owner or the Architect has reasonable objection to any such proposed person or entity or (2) that the Architect requires additional time for review. Failure of the Owner or Architect to reply 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 previously selected if the Owner or Architect makes reasonable objection to such substitution.

§ 5.3 SUBCONTRACTUAL RELATIONS

By appropriate agreement, written where legally required for validity, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work, which the Contractor, by these Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. 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 in writing; 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 such 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 Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and to award separate contracts in connection with other portions of the Project or other construction or operations on the site under Conditions of the Contract identical or substantially similar to these including those portions related to insurance and waiver of subrogation. If the Contractor claims that delay or additional cost is involved because of such action by the Owner, the Contractor shall make such Claim as provided in Article 15.

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

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

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

§ 6.2 MUTUAL RESPONSIBILITY

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

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a separate contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly report to the Architect apparent discrepancies or defects in such other construction that would render it unsuitable for such proper execution and results. Failure of the Contractor so to report shall constitute an acknowledgment that the Owner's or separate contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work, except as to defects not then reasonably discoverable.

§ 6.2.3 The 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 the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or separate contractors 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, and the Contractor shall proceed promptly, 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 7.3.7.

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

§ 7.3.5 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.

§ 7.3.6 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.

§ 7.3.7 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the method and the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for 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 7.3.7 shall be limited to the following:

- .1 Costs of labor, including social security, old age and unemployment insurance, fringe benefits required by agreement or custom, and workers' compensation insurance;
- .2 Costs of materials, supplies and equipment, including cost of transportation, whether incorporated or consumed;
- .3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;
- .4 Costs of premiums for all bonds and insurance, permit fees, and sales, use or similar taxes related to the Work; and
- .5 Additional costs of supervision and field office personnel directly attributable to the change.

§ 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 has authority to order minor changes in the Work not involving adjustment in the Contract Sum or extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such changes will be effected by written order signed by the Architect and shall be binding on the Owner and Contractor.

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, prematurely commence operations on the site or elsewhere prior to the effective date of insurance required by Article 11 to be furnished by the Contractor and Owner. The date of commencement of the Work shall not be changed by the effective date of such insurance.

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

§ 8.3 DELAYS AND EXTENSIONS OF TIME

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by an act or neglect of the Owner or Architect, or of an employee of either, or of a separate contractor employed by the Owner; or by changes ordered in the Work; or by labor disputes, fire, unusual delay in deliveries, unavoidable casualties or other causes beyond the Contractor's control; or by delay authorized by the Owner pending mediation and arbitration; or by other causes that the Architect determines may justify delay, then the Contract Time shall be extended by Change Order 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

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.

§ 9.2 SCHEDULE OF VALUES

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit to the Architect, before the first Application for Payment, a schedule of values allocating the entire Contract Sum to the various portions of the Work and prepared in such form and supported by such data to substantiate its accuracy as the Architect may require. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's 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. Such application shall be notarized, if required, and supported by such data substantiating the Contractor's right to payment as the Owner or Architect may require, such as copies of requisitions from Subcontractors and material suppliers, and 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 material 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, material suppliers, or other persons or entities making a claim by reason of having 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 issue to the Owner a Certificate for Payment, with a copy to the Contractor, for such amount as the Architect determines is properly due, or notify the Contractor and Owner in writing of the Architect's reasons for withholding certification in whole or in part as provided in Section 9.5.1.

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

§ 9.5 DECISIONS TO WITHHOLD CERTIFICATION

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

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

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

§ 9.5.3 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 material or equipment suppliers 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 Architect will reflect such payment on the next Certificate 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 material and equipment 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 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, except as may otherwise be required by law.

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

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

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

§ 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' written notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shut-down, delay and start-up, plus interest as provided for in the Contract Documents.

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

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in such Certificate. Upon such acceptance and consent of surety, if any, the Owner shall make payment of retainage applying to such 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 as required under Section 11.3.1.5 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 written 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 and, 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 terms and conditions of the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect and will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner, (3) a written statement that the Contractor knows of no substantial reason that the insurance will not be renewable to cover the period required by the Contract

Documents, (4) consent of surety, if any, to final payment and (5), if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claims, security interests or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. 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. If such lien 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 such lien, 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 and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

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

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

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 SAFETY PRECAUTIONS AND PROGRAMS

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

§ 10.2 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 or the Contractor's Subcontractors or Sub-subcontractors; and
- .3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

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

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

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

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in

whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3, except damage or loss attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

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

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

§ 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, written notice of such injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

§ 10.3 HAZARDOUS MATERIALS

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

§ 10.3.2 Upon receipt of the Contractor's written 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 such material or substance or who are to perform the task of removal or safe containment of such material or substance. The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. 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 in the amount of the Contractor's reasonable additional costs of shut-down, 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 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 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 indemnify the Owner for the cost and expense the Owner incurs (1) for remediation of a material or substance 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 indemnify 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 LIABILITY INSURANCE

§ 11.1.1 The Contractor shall purchase from and maintain in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located such insurance as will protect the Contractor from claims set forth below which may arise out of or result from the Contractor's operations and completed operations under the Contract and for which the Contractor may be legally liable, whether such operations be by the Contractor or by a Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

- .1 Claims under workers' compensation, disability benefit and other similar employee benefit acts that are applicable to the Work to be performed;
- .2 Claims for damages because of bodily injury, occupational sickness or disease, or death of the Contractor's employees;
- .3 Claims for damages because of bodily injury, sickness or disease, or death of any person other than the Contractor's employees;
- .4 Claims for damages insured by usual personal injury liability coverage;
- .5 Claims for damages, other than to the Work itself, because of injury to or destruction of tangible property, including loss of use resulting therefrom;
- .6 Claims for damages because of bodily injury, death of a person or property damage arising out of ownership, maintenance or use of a motor vehicle;
- .7 Claims for bodily injury or property damage arising out of completed operations; and
- .8 Claims involving contractual liability insurance applicable to the Contractor's obligations under Section 3.18.

§ 11.1.2 The insurance required by Section 11.1.1 shall be written for not less than limits of liability specified in the Contract Documents or required by law, whichever coverage is greater. Coverages, whether written on an occurrence or claims-made basis, shall be maintained without interruption from the date of commencement of the Work until the date of final payment and termination of any coverage required to be maintained after final payment, and, with respect to the Contractor's completed operations coverage, until the expiration of the period for correction of Work or for such other period for maintenance of completed operations coverage as specified in the Contract Documents.

§ 11.1.3 Certificates of insurance acceptable to the Owner shall be filed with the Owner prior to commencement of the Work and thereafter upon renewal or replacement of each required policy of insurance. These certificates and the insurance policies required by this Section 11.1 shall contain a provision that coverages afforded under the policies will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner. An additional certificate evidencing continuation of liability coverage, including coverage for completed operations, shall be submitted with the final Application for Payment as required by Section 9.10.2 and thereafter upon renewal or replacement of such coverage until the expiration of the time required by Section 11.1.2. Information concerning reduction of coverage on account of revised limits or claims paid under the General Aggregate, or both, shall be furnished by the Contractor with reasonable promptness.

§ 11.1.4 The Contractor shall cause the commercial liability coverage required by the Contract Documents to include (1) the Owner, the Architect and the Architect's consultants as additional insureds for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's operations; and (2) the Owner as an additional

insured for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's completed operations.

§ 11.2 OWNER'S LIABILITY INSURANCE

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

§ 11.3 PROPERTY INSURANCE

§ 11.3.1 Unless otherwise provided, the Owner shall purchase and maintain, in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located, property insurance written on a builder's risk "all-risk" or equivalent policy form in the amount of the initial Contract Sum, plus value of subsequent Contract Modifications and cost of materials supplied or installed by others, comprising total value for the entire Project at the site on a replacement cost basis without optional deductibles. Such property insurance shall be maintained, unless otherwise provided in the Contract Documents or otherwise agreed in writing by all persons and entities who are beneficiaries of such insurance, until final payment has been made as provided in Section 9.10 or until no person or entity other than the Owner has an insurable interest in the property required by this Section 11.3 to be covered, whichever is later. This insurance shall include interests of the Owner, the Contractor, Subcontractors and Sub-subcontractors in the Project.

§ 11.3.1.1 Property insurance shall be on an "all-risk" or equivalent policy form and shall include, without limitation, insurance against the perils of fire (with extended coverage) and physical loss or damage including, without duplication of coverage, theft, vandalism, malicious mischief, collapse, earthquake, flood, windstorm, falsework, testing and startup, temporary buildings and debris removal including demolition occasioned by enforcement of any applicable legal requirements, and shall cover reasonable compensation for Architect's and Contractor's services and expenses required as a result of such insured loss.

§ 11.3.1.2 If the Owner does not intend to purchase such property insurance required by the Contract and with all of the coverages in the amount described above, the Owner shall so inform the Contractor in writing prior to commencement of the Work. The Contractor may then effect insurance that will protect the interests of the Contractor, Subcontractors and Sub-subcontractors in the Work, and by appropriate Change Order the cost thereof shall be charged to the Owner. If the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain insurance as described above, without so notifying the Contractor in writing, then the Owner shall bear all reasonable costs properly attributable thereto.

§ 11.3.1.3 If the property insurance requires deductibles, the Owner shall pay costs not covered because of such deductibles.

§ 11.3.1.4 This property insurance shall cover portions of the Work stored off the site, and also portions of the Work in transit.

§ 11.3.1.5 Partial occupancy or use in accordance with Section 9.9 shall not commence until the insurance company or companies providing property insurance have consented to such partial occupancy or use by endorsement or otherwise. The Owner and the Contractor shall take reasonable steps to obtain consent of the insurance company or companies and shall, without mutual written consent, take no action with respect to partial occupancy or use that would cause cancellation, lapse or reduction of insurance.

§ 11.3.2 BOILER AND MACHINERY INSURANCE

The Owner shall purchase and maintain boiler and machinery insurance required by the Contract Documents or by law, which shall specifically cover such insured objects during installation and until final acceptance by the Owner; this insurance shall include interests of the Owner, Contractor, Subcontractors and Sub-subcontractors in the Work, and the Owner and Contractor shall be named insureds.

§ 11.3.3 LOSS OF USE INSURANCE

The Owner, at the Owner's option, may purchase and maintain such insurance as will insure the Owner against loss of use of the Owner's property due to fire or other hazards, however caused. The Owner waives all rights of action against the Contractor for loss of use of the Owner's property, including consequential losses due to fire or other hazards however caused.

§ 11.3.4 If the Contractor requests in writing that insurance for risks other than those described herein or other special causes of loss be included in the property insurance policy, the Owner shall, if possible, include such insurance, and the cost thereof shall be charged to the Contractor by appropriate Change Order.

§ 11.3.5 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, the Owner shall waive all rights in accordance with the terms of Section 11.3.7 for damages caused by fire or other causes of loss covered by this separate property insurance. All separate policies shall provide this waiver of subrogation by endorsement or otherwise.

§ 11.3.6 Before an exposure to loss may occur, the Owner shall file with the Contractor a copy of each policy that includes insurance coverages required by this Section 11.3. Each policy shall contain all generally applicable conditions, definitions, exclusions and endorsements related to this Project. Each policy shall contain a provision that the policy will not be canceled or allowed to expire, and that its limits will not be reduced, until at least 30 days' prior written notice has been given to the Contractor.

§ 11.3.7 WAIVERS OF SUBROGATION

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, and (2) the Architect, Architect's consultants, separate contractors described in Article 6, 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 covered by property insurance obtained pursuant to this Section 11.3 or other property insurance applicable to the Work, except such rights as they have to proceeds of such insurance held by the Owner as fiduciary. The Owner or Contractor, as appropriate, shall require of the Architect, Architect's consultants, separate contractors described in Article 6, if any, and the subcontractors, sub-subcontractors, agents and employees of any of them, by appropriate agreements, written where legally required for validity, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, and whether or not the person or entity had an insurable interest in the property damaged.

§ 11.3.8 A loss insured under the Owner's property insurance 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 11.3.10. The Contractor shall pay Subcontractors their just shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors to make payments to their Sub-subcontractors in similar manner.

§ 11.3.9 If required in writing by a party in interest, the Owner as fiduciary shall, upon occurrence of an insured loss, give bond for proper performance of the Owner's duties. The cost of required bonds shall be charged against proceeds received as fiduciary. The Owner shall deposit in a separate account proceeds so received, which the Owner shall distribute in accordance with such agreement as the parties in interest may reach, or as determined in accordance with the method of binding dispute resolution selected in the Agreement between the Owner and Contractor. If after such loss no other special agreement is made and unless the Owner terminates the Contract for convenience, replacement of damaged property shall be performed by the Contractor after notification of a Change in the Work in accordance with Article 7.

§ 11.3.10 The Owner as fiduciary shall have power to adjust and settle a loss with insurers unless one of the parties in interest shall object in writing within five days after occurrence of loss to the Owner's exercise of this power; if such objection is made, the dispute shall be resolved in the manner selected by the Owner and Contractor as the method of binding dispute resolution in the Agreement. If the Owner and Contractor have selected arbitration as the method of binding dispute resolution, the Owner as fiduciary shall make settlement with insurers or, in the case of a dispute over distribution of insurance proceeds, in accordance with the directions of the arbitrators.

§ 11.4 PERFORMANCE BOND AND PAYMENT BOND

§ 11.4.1 The Owner shall have the right to require the Contractor to furnish bonds covering faithful performance of the Contract and payment of obligations arising thereunder as stipulated in bidding requirements or specifically required in the Contract Documents on the date of execution of the Contract.

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

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 UNCOVERING OF WORK

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

§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, costs of uncovering and replacement shall, by appropriate Change Order, be at the Owner's expense. If such Work is not in accordance with the Contract Documents, such costs and the cost of correction shall be at the Contractor's expense unless the condition was caused by the Owner or a separate contractor in which event the Owner shall be responsible for payment of such costs.

§ 12.2 CORRECTION OF WORK

§ 12.2.1 BEFORE OR AFTER SUBSTANTIAL COMPLETION

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

§ 12.2.2 AFTER SUBSTANTIAL COMPLETION

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of an applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of written notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.4.

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

§ 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, whether completed or partially completed, of the Owner or separate contractors caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be

sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

§ 12.3 ACCEPTANCE OF NONCONFORMING WORK

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 except that, 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 such 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 such assignment.

§ 13.3 WRITTEN NOTICE

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

§ 13.4 RIGHTS AND REMEDIES

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

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

§ 13.5 TESTS AND INSPECTIONS

§ 13.5.1 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 (1) tests, inspections or approvals that do not become requirements until after bids are received or negotiations concluded, and (2) tests, inspections or approvals where building codes or applicable laws or regulations prohibit the Owner from delegating their cost to the Contractor.

§ 13.5.2 If the Architect, Owner or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection or approval not included under Section 13.5.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection or approval by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.5.3, shall be at the Owner's expense.

§ 13.5.3 If such procedures for testing, inspection or approval under Sections 13.5.1 and 13.5.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure including those of repeated procedures and compensation for the Architect's services and expenses shall be at the Contractor's expense.

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

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

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

§ 13.6 INTEREST

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at such rate as the parties may 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.

§ 13.7 TIME LIMITS ON CLAIMS

The Owner and Contractor shall commence all claims and causes of action, whether in contract, tort, breach of warranty or otherwise, against the other arising out of or related to the Contract in accordance with the requirements of the final dispute resolution method selected in the Agreement within the time 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 13.7.

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 or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, for any of the following reasons:

- .1 Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
- .2 An act of government, such as a declaration of national emergency that requires all Work to be stopped;
- .3 Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or
- .4 The Owner has failed to furnish to the Contractor promptly, upon the Contractor's request, reasonable evidence as required by Section 2.2.1.

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

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' written notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, including reasonable overhead and profit, costs incurred by reason of such termination, and damages.

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

§ 14.2 TERMINATION BY THE OWNER FOR CAUSE

§ 14.2.1 The Owner may terminate the Contract if the Contractor

- .1 repeatedly refuses or fails to supply enough properly skilled workers or proper materials;
- .2 fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;
- .3 repeatedly disregards 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 above reasons exist, the Owner, upon certification by the Initial Decision Maker that sufficient cause exists to justify such action, 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' written notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

- .1 Exclude the Contractor from the site and take possession of 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 as described in Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent

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

§ 14.4 TERMINATION BY THE OWNER FOR CONVENIENCE

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

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

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

§ 14.4.3 In case of such termination for the Owner's convenience, the Contractor shall be entitled to receive payment for Work executed, and costs incurred by reason of such termination, along with reasonable overhead and profit on the Work not executed.

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, 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.

§ 15.1.2 NOTICE OF CLAIMS

Claims by either the Owner or Contractor must be initiated by written 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 must be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

§ 15.1.3 CONTINUING CONTRACT PERFORMANCE

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. The Architect will prepare Change Orders and issue Certificates for Payment in accordance with the decisions of the Initial Decision Maker.

§ 15.1.4 CLAIMS FOR ADDITIONAL COST

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

§ 15.1.5 CLAIMS FOR ADDITIONAL TIME

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

§ 15.1.5.2 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.

§ 15.1.6 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 15.1.6 shall be deemed to preclude an award of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.2 INITIAL DECISION

§ 15.2.1 Claims, excluding those arising under Sections 10.3, 10.4, 11.3.9, and 11.3.10, 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 arising prior to the date final payment is due, unless 30 days have passed after the Claim has been referred to the Initial Decision Maker with no 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 such 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 an initial decision, demand in writing that the other party file for mediation within 60 days of the initial decision. If such a demand is made and the party receiving the demand fails to file for mediation within the time required, 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 15.1.6 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 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. 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 Either party, at its sole discretion, 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 Either party, at its sole discretion, 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 the Owner and Contractor under this Agreement.

Additions and Deletions Report for **AIA® Document A201® – 2007**

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 14:01:32 MT on 11/18/2020.

PAGE 1

Layton City Fire Station 54
Layton, Utah

...

Layton City, General Corporation
437 North Wasatch Drive
Layton, Utah 84041

...

Think Architecture, Inc., Subchapter S Corporation
7927 High Point Pkwy, Ste 300
Sandy, UT 84094

Certification of Document's Authenticity

AIA® Document D401™ – 2003

I, Corey R. Solum, AIA, 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 14:01:32 MT on 11/18/2020 under Order No. 8184578310 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™ – 2007, General Conditions of the Contract for Construction, as published by the AIA in its software, other than those additions and deletions shown in the associated Additions and Deletions Report.

(Signed)

(Title)

(Dated)

SECTION 00 3132 - 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 but, are not a warranty of existing conditions. This Document and its attachments are not part of the Contract Documents.
- B. A geotechnical investigation report for the Project, prepared by **CMT Engineering Laboratories**, dated **August 11, 2020 (CMT Project No. 14961)** is attached following this section and labeled as: 00 3132.01 – GeoTechnical Soils Investigation Report.
- C. Related Requirements:
 - 1. Document 00 2113 "Instructions to Bidders" for the Bidder's responsibilities for examination of Project site and existing conditions.

END OF DOCUMENT 00 3132



GEOTECHNICAL ENGINEERING STUDY

Proposed East Layton Fire Station

1100 North Valley View Drive
Layton, Utah

CMT PROJECT NO. 14961

FOR:

Think Architecture

7927 South High Point Parkway, Suite 300
Sandy, Utah 84094

August 11, 2020

ENGINEERING • GEOTECHNICAL • ENVIRONMENTAL (ESA I & II) •
MATERIALS TESTING • SPECIAL INSPECTIONS •
ORGANIC CHEMISTRY • PAVEMENT
DESIGN • GEOLOGY

August 11, 2020

Mr. Jim Polonic
Think Architecture
7927 South High Point Parkway, Suite 300
Sandy, Utah 84094

Subject: Geotechnical Engineering Study
Proposed East Layton Fire Station
1100 North Valley View Drive
Layton, Utah
CMT Project Number: 14961

Mr. Polonic:

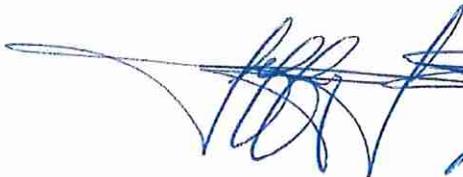
Submitted herewith is the report of our geotechnical engineering study for the subject site. This report contains the results of our findings and an engineering interpretation of the results with respect to the available project characteristics. It also contains recommendations to aid in the design and construction of the earth related phases of this project.

On July 29, 2020, a CMT Engineering Laboratories (CMT) staff professional was on-site and supervised the drilling of 7 bore holes extending to depths of about 5 to 23 feet below the existing ground surface. Soil samples were obtained during the field operations and subsequently transported to our laboratory for further testing and observation.

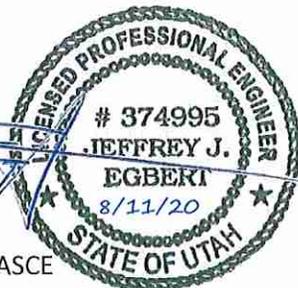
Conventional spread and/or continuous footings may be utilized to support the proposed structure, provided the recommendations in this report are followed. A detailed discussion of design and construction criteria is presented in this report.

We appreciate the opportunity to work with you at this stage of the project. CMT offers a full range of Geotechnical Engineering, Geological, Material Testing, Special Inspection services, and Phase I and II Environmental Site Assessments. With offices throughout Utah, Idaho and Arizona, our staff is capable of efficiently serving your project needs. If we can be of further assistance or if you have any questions regarding this project, please do not hesitate to contact us at 801-492-4132 or 801-870-6730.

Sincerely,
CMT Engineering Laboratories



Jeffrey J. Egbert, P.E., LEED A.P., M. ASCE
Senior Geotechnical Engineer



Reviewed by:



William G. Turner, P.E.
Senior Geotechnical Engineer

TABLE OF CONTENTS

1.0 INTRODUCTION	1
<u>1.1 General</u>	1
<u>1.2 Objectives, Scope and Authorization</u>	1
<u>1.3 Description of Proposed Construction</u>	2
<u>1.4 Executive Summary</u>	2
2.0 FIELD EXPLORATION	3
<u>2.1 General</u>	3
<u>2.2 Infiltration Testing</u>	3
3.0 LABORATORY TESTING	3
4.0 GEOLOGIC & SEISMIC CONDITIONS	4
<u>4.1 Geologic Setting</u>	4
<u>4.2 Faulting</u>	6
<u>4.3 Seismicity</u>	6
4.3.1 Site Class	6
4.3.2 Ground Motions.....	6
4.3.3 Liquefaction	7
<u>4.4 Other Geologic Hazards</u>	8
5.0 SITE CONDITIONS	8
<u>5.1 Surface Conditions</u>	8
<u>5.2 Subsurface Soils</u>	8
<u>5.3 Groundwater</u>	9
<u>5.4 Site Subsurface Variations</u>	9
6.0 SITE PREPARATION AND GRADING	9
<u>6.1 General</u>	9
<u>6.2 Temporary Excavations</u>	10
<u>6.3 Fill Material</u>	11
<u>6.4 Fill Placement and Compaction</u>	11
<u>6.5 Utility Trenches</u>	12
<u>6.6 Stabilization</u>	12
7.0 FOUNDATION RECOMMENDATIONS	13
<u>7.1 Foundation Recommendations</u>	13
<u>7.2 Installation</u>	14
<u>7.3 Estimated Settlement</u>	14
<u>7.4 Lateral Resistance</u>	14
8.0 LATERAL EARTH PRESSURES	14
9.0 FLOOR SLABS	15
10.0 DRAINAGE RECOMMENDATIONS	15
11.0 PAVEMENTS	16
12.0 QUALITY CONTROL	17
<u>12.1 Field Observations</u>	17
<u>12.2 Fill Compaction</u>	17
<u>12.3 Excavations</u>	17
13.0 LIMITATIONS	17

APPENDIX

- Figure 1: Site Map
- Figures 2 -8: Bore Hole Logs
- Figure 9: Key to Symbols

available data, performing engineering analyses, and preparing this summary report. This scope of work was authorized by returning a signed copy of our proposal dated July 13, 2020 and executed on July 14, 2020.

1.3 Description of Proposed Construction

We understand that the proposed construction consists of a new fire station building with up to 2 levels above grade and a possible single level below grade. We project that wall loads will not exceed 8,000 pounds per linear foot and column loads will not exceed 100,000 pounds. Floor slab loads, with the exception of fire truck parking areas, are anticipated to be relatively light, with an average uniform loading not exceeding 150 pounds per square foot. If the loading conditions are different than we have projected, please notify us so that any appropriate modifications to our conclusions and recommendations contained herein can be made.

Parking/drive paved areas will also be constructed, which we anticipate will utilize both asphalt and concrete pavement. Traffic is projected to consist of automobiles and light trucks for parking areas, and for drive lanes including up to three large fire trucks, an occasional medium-weight delivery truck, and a weekly garbage truck.

Site development will require some earthwork in the form of cutting and filling. A site grading plan was not available at the time of this report, but we project that maximum cuts and fills may be on the order of 5 to 6 feet. If deeper cuts or fills are planned, CMT should be notified to provide additional recommendations, if needed.

1.4 Executive Summary

The most significant geotechnical aspects regarding site development include the following:

1. Approximately 1.5 to 5.5 feet, and possibly up to 8.0 feet, of undocumented fill blankets the site; foundations and floor slabs should not be placed on undocumented fill.
2. Subsurface natural soils were predominately granular, consisting of GRAVEL (GC, GM, GP) and SAND (SM) layers, with an occasional CLAY (CL) layer.
3. Groundwater was not encountered within the maximum depth explored of approximately 23 feet below the existing surface.
4. Foundations and floor slabs may be constructed on suitable undisturbed natural soils or on structural/engineered fill which extends to suitable natural soils.

CMT must assess that topsoil, undocumented fills, debris, disturbed or unsuitable soils have been removed and that suitable soils have been encountered prior to placing site grading fills, footings, slabs, and pavements.

In the following sections, detailed discussions pertaining to the site are provided, including subsurface descriptions, geologic setting, seismicity, earthwork, foundations, lateral resistance, lateral pressure, floor slabs, and pavements.

2.0 FIELD EXPLORATION

2.1 General

In order to define and evaluate the subsurface soil and groundwater conditions 7 bore holes were drilled at the site to depths of approximately 5 to 23 feet below the existing ground surface. We attempted to drill one bore hole (B-1) to a depth of 45 feet, but encountered auger refusal at a depth of 23 feet at that location. Locations of the bore holes are presented on **Figure 1**.

Samples of the subsurface soils encountered in the bore holes were collected at varying depths through the hollow stem drill augers. Disturbed samples were collected utilizing a standard split spoon sampler. This standard split spoon sampler was driven 18 inches into the soils below the drill augers using a 140-pound hammer free-falling a distance of 30 inches. The number of hammer blows needed for each 6-inch interval was recorded. The sum of the hammer blows for the final 12 inches of penetration is known as a standard penetration test and this 'blow count' was recorded on the bore hole logs. Where more than 50 blows occurred before the 6-inch interval was achieved, the sampling was terminated and the number of blows and inches penetrated by the sampler were recorded. The blow count provides a reasonable approximation of the relative density of granular soils, but only a limited indication of the relative consistency of fine-grained soils because the consistency of these soils is significantly influenced by the moisture content. Some small bag samples of the subsurface soils from the auger cuttings were also collected.

The subsurface soils encountered in the bore holes were classified in the field based upon visual and textural examination, logged and described in general accordance with ASTM¹ D-2488. These field classifications were supplemented by subsequent examination and testing of select samples in our laboratory. Logs of the bore holes, including a description of the soil strata encountered, are presented on each individual **Bore Hole Log, Figures 2 through 8**, included in the Appendix. Sampling information and other pertinent data and observations are also included on the logs. In addition, a **Key to Symbols** defining the terms and symbols used on the logs is provided as **Figure 9** in the Appendix.

2.2 Infiltration Testing

Infiltration tests were also performed as part of our field exploration within bore holes B-4 and B-6, at 5.0 to 5.5 feet below the surface. The testing consisted of filling the inside of the auger with water, and measuring the rate of water drop over a certain time period (i.e. 10 minutes). The results of these tests indicate infiltration rates of about 1 to 1.3 minutes per inch at the locations of B-4 and B-6, respectively.

3.0 LABORATORY TESTING

Selected samples of the subsurface soils were subjected to various laboratory tests to assess pertinent engineering properties, as follows:

¹American Society for Testing and Materials

1. Moisture Content, ASTM D-2216, Percent moisture representative of field conditions
2. Atterberg Limits, ASTM D-4318, Plasticity and workability
3. Gradation Analysis, ASTM D-1140/C-117, Grain Size Analysis

Laboratory test results are presented on the bore hole logs (Figures 2 through 8) and in the following Lab Summary Table:

LAB SUMMARY TABLE

BORE HOLE	DEPTH (feet)	SAMPLE TYPE	SOIL CLASS	MOISTURE CONTENT(%)	GRADATION			ATTERBERG LIMITS		
					GRAV.	SAND	FINES	LL	PL	PI
B-1	5	SPT	GM	3			18			
	10	SPT	SM	9	16	54	30		NP	NP
	19	SPT	GM	7			26			
B-2	5	SPT	GC	8			22			
B-3	2.5	SPT	GC	6			24			
	5	SPT	SM	8			29		NP	NP
B-4	4.5	Bag	FILL (SM)	8	31	42	27			
B-6	2.5	SPT	FILL (SM)	11	4	67	29			

4.0 GEOLOGIC & SEISMIC CONDITIONS

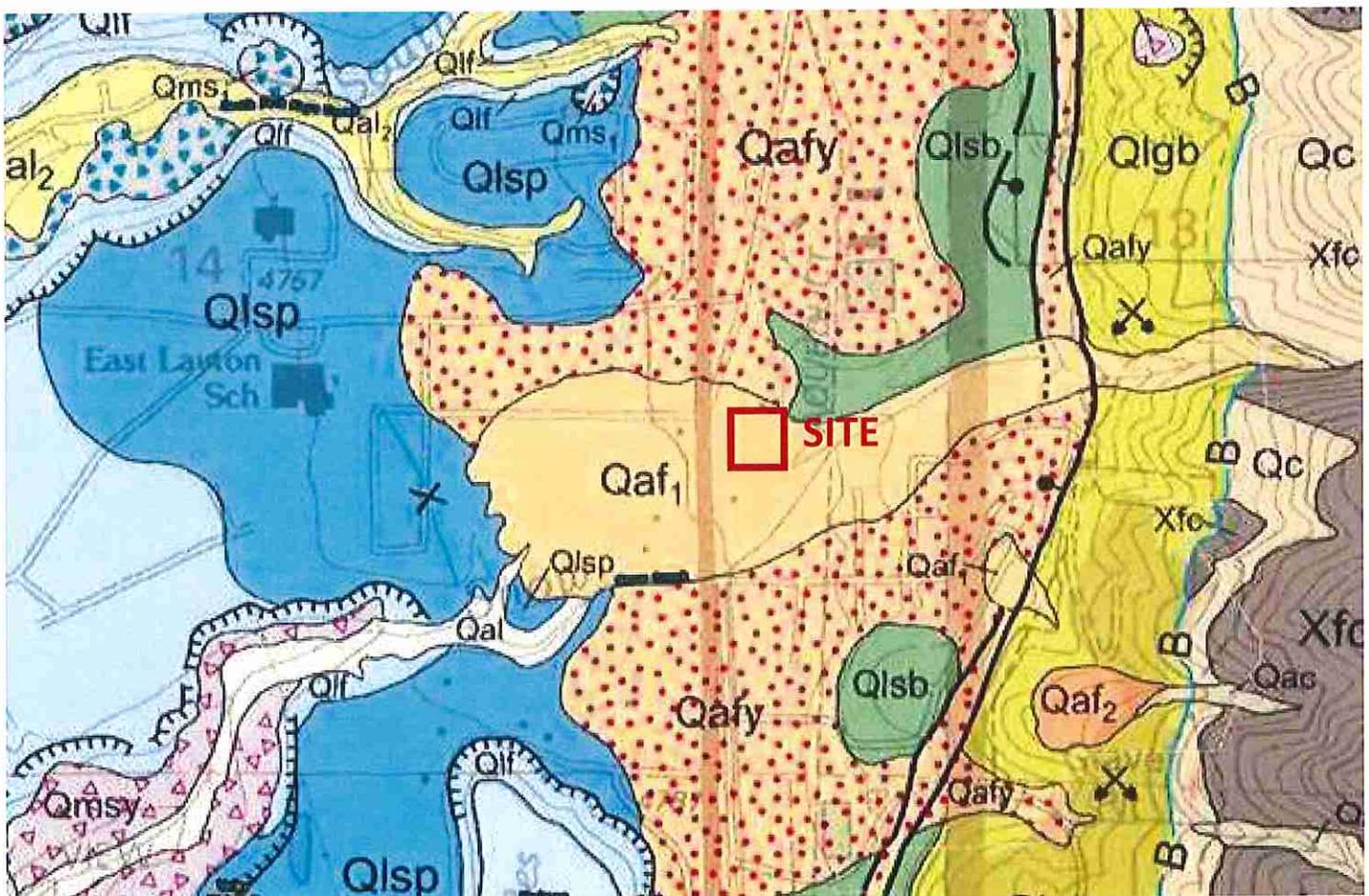
4.1 Geologic Setting

The subject site is located in the northeast portion of Davis County in north-central Utah at an elevation of approximately 4,834 feet above sea level. The site is located in a valley bounded by the Wasatch Mountains on the east and Antelope Island (Great Salt Lake) and the Promontory Mountains to the west. The valley is a deep, sediment-filled basin that is part of the Basin and Range Physiographic Province and was formed by extensional tectonic processes during the Tertiary and Quaternary geologic time periods. The valley is located within the Intermountain Seismic Belt, a zone of ongoing tectonism and seismic activity extending from southwestern Montana to southwestern Utah. The active (evidence of movement in the last 10,000 years) Wasatch Fault Zone is part of the Intermountain Seismic Belt and extends from southeastern Idaho to central Utah along the western base of the Wasatch Mountain Range.

Much of northwestern Utah, including the valley in which the subject site is located, was also previously covered by the Pleistocene age Lake Bonneville. The Great Salt Lake, located along the western margin of the valley and beyond, is a remnant of this ancient fresh water lake. Lake Bonneville reached a high-stand elevation of between approximately 5,160 and 5,200 feet above sea level at between 18,500 and 17,400 years ago. Approximately 17,400 years ago, the lake breached its basin in southeastern Idaho and dropped by almost 300 feet relatively fast as water drained into the Snake River. Following this catastrophic release, the lake level continued to drop slowly over time, primarily driven by drier climatic conditions, until reaching the current level of the Great Salt Lake. Shoreline terraces formed at the high-stand elevation of the lake and several subsequent lower lake levels are visible in places on the mountain slopes surrounding the valley. Much of the sediment

within the Valley was deposited as lacustrine sediments during both the transgressive (rise) and regressive (fall) phases of Lake Bonneville and in older, pre-Bonneville lakes that previously occupied the basin.

The geology of the USGS Kaysville, Utah 7.5 Minute Quadrangle, that includes the location of the subject site, has been mapped by Solomon². The surficial geology at the location of the subject site and adjacent properties is mapped as “Modern (level 1) alluvial-fan deposits” Map Unit (Qaf₁) dated as upper Holocene. No fill has been mapped at the location of the site on the geologic map. Unit Qaf₁ is described in the referenced mapping as “Poorly to moderately sorted, weakly to non-stratified, silt- to boulder-size sediment deposited principally by debris flows and debris floods at the mouths of mountain-front canyons; upper parts characterized by abundant boulders and debris-flow levees that radiate away from the fan apex; small, finer grained alluvial-fan deposits are found on gentle slopes in the northern part of the quadrangle, deposited by shallow, dispersive flows; equivalent to the younger part of Qafy but differentiated where deposits can be mapped separately; commonly overlies lacustrine and older alluvial-fan deposits; debris-flow and debris-flood hazards are highest on modern alluvial fans, their undivided equivalents within younger alluvial fans (Qafy), and debris-flow deposits (Qmf); less than 30 feet (9 m) thick.” Refer to the **Geologic Map**, shown below.



GEOLOGIC MAP

²Solomon, B.J., 2007, Surficial Geologic Map of Part of the Kaysville Quadrangle, Davis County, Utah; Utah Geological Survey Map 224, Scale 1:24,000.

4.2 Faulting

No surface fault traces are shown on the referenced geologic map crossing, adjacent to, or projecting toward the subject site. The nearest active (Holocene) fault is the Weber Segment of the Wasatch Fault Zone approximately 1,400 feet to the east. Note that significant shaking will likely occur at the site if an earthquake were to occur on this or nearby fault segments. Seismic design issues are addressed in **Section 4.3** below.

4.3 Seismicity

4.3.1 Site Class

Utah has adopted the International Building Code (IBC) 2018, which determines the seismic hazard for a site based upon 2014 mapping of bedrock accelerations prepared by the United States Geologic Survey (USGS) and the soil site class. The USGS values are presented on maps incorporated into the IBC code and are also available based on latitude and longitude coordinates (grid points). For site class definitions, IBC 2018 Section 1613.2.2 refers to Chapter 20, Site Classification Procedure for Seismic Design, of ASCE³ 7-16, which stipulates that the average values of shear wave velocity, blow count and/or shear strength within the upper 100 feet (30 meters) be utilized to determine seismic site class. Based on average shear wave velocity data within the upper 30 meters ($V_{s,30}$) published by McDonald and Ashland⁴, the subject site is located within unit description Q03D, which has an assigned log-mean $V_{s,30}$ of 349 meters per second (1145 feet per second). Thus, it is our opinion the site best fits Site Class D – Stiff Soil Profile (with data), which we recommend for seismic structural design.

4.3.2 Ground Motions

The 2014 USGS mapping utilized by the IBC provides values of peak ground, short period and long period spectral accelerations for the Site Class B/C boundary and the Risk-Targeted Maximum Considered Earthquake (MCE_R). This Site Class B/C boundary represents average bedrock values for the Western United States and must be corrected for local soil conditions at site grid coordinates of 41.0793 degrees north latitude and -111.9102 degrees west longitude. The following table and response spectra summarizes the peak ground, short period and long period accelerations for the MCE_R event, and incorporates appropriate soil correction factors for a Site Class D (with data) soil profile :

³American Society of Civil Engineers

⁴ McDonald, G.N. and Ashland, F.X., 2008, "Earthquake Site-Conditions Map for the Wasatch Front Urban Corridor, Utah," Utah Geological Survey Special Study 125, 41 pp.

SPECTRAL ACCELERATION PERIOD, T	SITE CLASS B/C BOUNDARY [mapped values] (g)	SITE COEFFICIENT	SITE CLASS D* [adjusted for site class effects] (g)	MULTIPLIER	DESIGN VALUES (g)
Peak Ground Acceleration	PGA = 0.581	$F_{pga} = 1.100$	$PGA_M = 0.639$	1.000	$PGA_M = 0.639$
0.2 Seconds (Long Period Acceleration)	$S_S = 1.262$	$F_a = 1.000$	$S_{MS} = 1.262$	0.667	$S_{DS} = 0.841$
	(no exceptions needed)	$F_a = (N/A)$	$S_{MS} = (N/A)$	0.667	$S_{DS} = (N/A)$
1.0 Second (Long Period Acceleration)	$S_1 = 0.472$	$F_v = N/A$	$S_{M1} = N/A$	0.667	$S_{D1} = N/A$
	(Exception 2:)	$F_v = (1.828)$	$S_{M1} = (0.863)$	0.667	$S_{D1} = (0.575)$

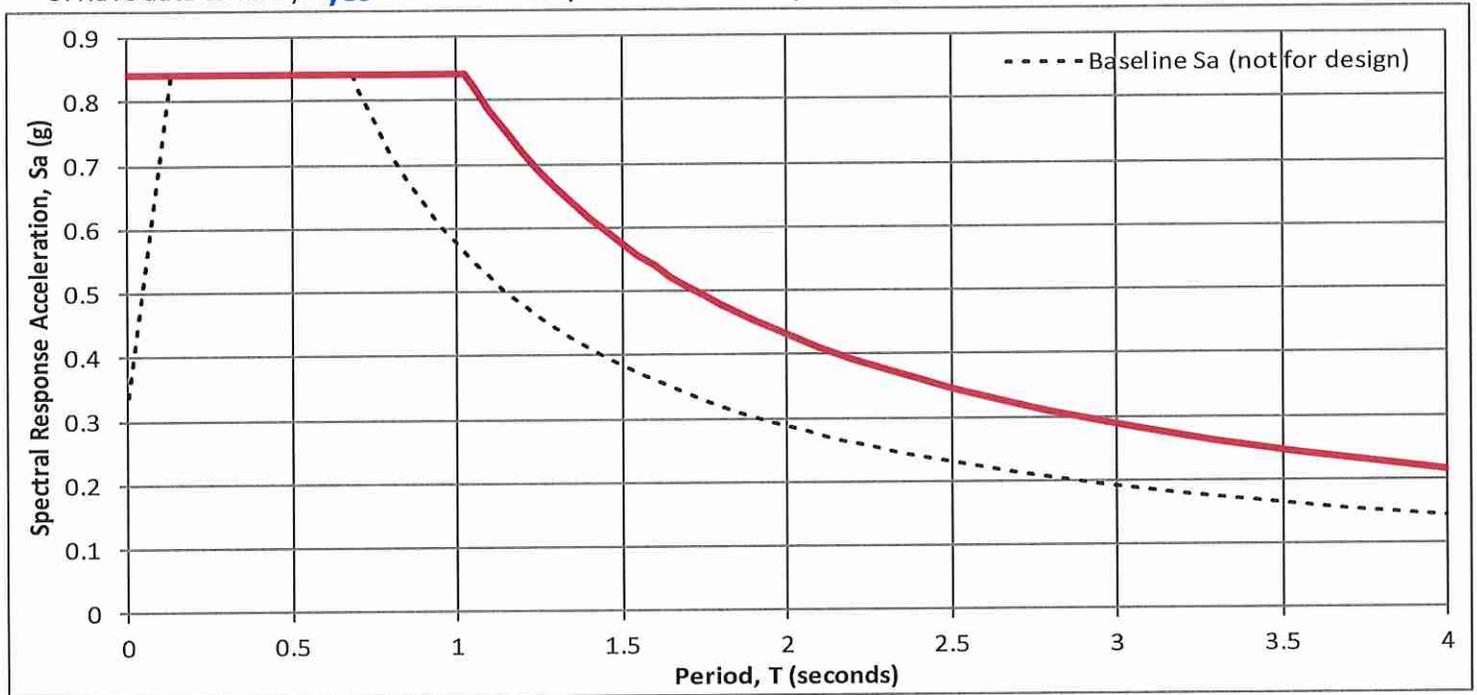
NOTES: 1. TL (seconds): **8**

2. Site Class: **D**

3. Have data to verify? **yes**

* Site Class D With Data

4. ASCE 7-16 Requires Site-Specific Ground Motion Hazard Analysis (Since $S_1 \geq 0.2$ sec) - OR Can Use Exception 2 (per §11.4.8) (S_a/C_s Plot Assumes $R=1.0$)



As indicated in the above table, S_1 is greater than 0.2 seconds and a site-specific ground motion hazard analysis (GMHA) is required for the site, unless the Exception 2 values shown are used for seismic design. If a site-specific GMHA is desired instead of using the higher exception values, please contact CMT for a proposal to perform the GMHA.

4.3.3 Liquefaction

Liquefaction is defined as the condition when saturated, loose, sandy soils lose their support capabilities because of excessive pore water pressure which develops during a seismic event. Clayey soils, even if saturated, will generally not liquefy during a major seismic event.

The site is located within an area designated by the Utah Geologic Survey⁵ as having "Moderate" liquefaction potential. This is considered as having between a 10 and 50% probability that within a 100-year period and earthquake strong enough to cause liquefaction will occur. Subsurface soils encountered in the bore holes consisted of sands and gravels, while groundwater was not encountered. In our opinion, the soils we encountered have a very low liquefaction potential.

4.4 Other Geologic Hazards

No landslide deposits or features, including lateral spread deposits, are mapped on or adjacent to the site. The site is not located within a known or mapped potential rock-fall hazard area. The site is located on the mid-fan portion of an alluvial fan extending from the mouth of Snow Creek Canyon to the east. Based on the mapped geology described above, the alluvial fan is active and, therefore, potential debris flow and fan flooding hazards are present. A residential subdivision has been developed on the apex of the alluvial fan area to the east of the site. The FEMA National Flood Hazard Layer Viewer⁶ indicates that the subject site is located in an "Area of minimal flood hazard" but does show a "Zone A" flood hazard zone along the projected Snow Creek drainage just south of the site. The Zone A Flood Hazard Zone is defined as having a 1% annual chance flood hazard.

5.0 SITE CONDITIONS

5.1 Surface Conditions

At the time the bore holes were drilled it appeared the site had been graded and fill soils placed and/or stockpiled on the surface of the site. Overall, the gradient in the area slopes downward to the west. Based upon aerial photos readily available online dating back to 1993 the site has been undeveloped since that time. The site is bordered on the north and south by undeveloped land, on the east by Valley View Drive, and on the west by undeveloped land with Highway 89 beyond (see **Vicinity Map** in **Section 1.1** above).

5.2 Subsurface Soils

At the locations of the bore holes we encountered fill soils, considered to be undocumented/untested, consisting of gravel and sand, extending to depths of about 1.5 to 5.5 feet, and possibly up to 8.0 feet, below the existing surface. The depth and lateral extent of the fill soils should be expected to vary. Natural soils encountered beneath the fill soils consisted of Clayey to Silty GRAVEL (GC, GM) layers with varying amounts of sand and cobbles, Poorly Graded GRAVEL (GP) with sand, Silty SAND (SM) layers with varying amounts of gravel, and an occasional relatively thin layer of CLAY (CL), extending to the bottom of the bore holes.

⁵ Utah Geological Survey, "Liquefaction-Potential Map for a Part of Davis County, Utah," Utah Geological Survey Public Information Series 24, August 1994. https://ugspub.nr.utah.gov/publications/public_information/pi-24.pdf

⁶ <https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html?id=8b0adb51996444d4879338b5529aa9cd&extent=-111.36752238312305,40.474000783564726,-111.34675135651116,40.48216171946493>

The natural gravel and sand soils were slightly moist, dark brown to reddish-brown in color, and in a loose to very dense state based on the SPT blow counts. These soils are projected to exhibit moderately high strength and low compressibility characteristics.

The clay layer was slightly moist, brown in color, and medium stiff in consistency.

For a more descriptive interpretation of subsurface conditions, please refer to the bore hole logs, **Figures 2 through 8**, which graphically represent the subsurface conditions encountered. The lines designating the interface between soil types on the logs generally represent approximate boundaries; in situ, the transition between soil types may be gradual.

5.3 Groundwater

Groundwater was not encountered at the time of our field explorations to the maximum depth explored of about 23 feet below the existing ground surface. Therefore, groundwater is not anticipated to be encountered during construction.

Groundwater levels can fluctuate seasonally and in response to numerous other factors such as heavy precipitation, irrigation of neighboring land, and other unforeseen factors. The detailed evaluation of these and other factors, which may be responsible for ground water fluctuations, is beyond the scope of this study.

5.4 Site Subsurface Variations

Based on the results of the subsurface explorations and our experience, variations in the continuity and nature of subsurface conditions should be anticipated. Due to the heterogeneous characteristics of natural soils, care should be taken in interpolating or extrapolating subsurface conditions between or beyond the exploratory locations.

6.0 SITE PREPARATION AND GRADING

6.1 General

Based upon the conditions observed at the time of our subsurface exploration, approximately 1.5 to 5.5 feet, but possibly as much as 8.0 feet, of undocumented fill is present on the surface of the site. The depth and lateral extent of the fill soils should be expected to vary. All undocumented fill shall be removed from beneath an area extending at least 5 feet beyond the proposed building footprint.

Outside of the building footprint, the existing fill can be prepared for support of exterior concrete flatwork and pavements. Proper preparation of undocumented fill and disturbed soils shall consist of removing the upper 18 to 24 inches, scarifying the exposed surface to a minimum depth of 8 inches, moisture conditioning as needed, and re-compacting the scarified soils in place to 95% of the maximum dry density. The removed fill, if free of debris or other deleterious materials, may then be replaced in similarly compacted lifts. These efforts will

reduce, but not eliminate, the potential for settlement and distress to pavements and exterior concrete flatwork and ongoing maintenance by leaving the undocumented fill in place, particularly where the existing fill depths exceed approximately 3 to 4 feet.

Prior to placing pavement materials the exposed subgrade must be proofrolled by passing moderate-weight rubber tire-mounted construction equipment over the surface at least twice. If excessively soft or loose soils are encountered, they must be removed (up to a maximum depth of 2 feet) and replaced with structural fill.

All other deleterious materials should be stripped from the site prior to commencement of construction activities. This includes vegetation, topsoil, etc.

The site should be observed by a CMT geotechnical engineer to assess that suitable natural soils have been exposed, and any deleterious materials, loose and/or disturbed soils have been removed, prior to placing site grading fills, footings, slabs, and pavements.

Fill placed over large areas to raise overall site grades can induce settlements in the underlying natural soils. If more than 3 feet of site grading fill is anticipated over the natural ground surface, we should be notified to assess potential settlements and provide additional recommendations as needed. These recommendations may include placement of the site grading fill far in advance to allow potential settlements to occur prior to construction.

6.2 Temporary Excavations

Excavations deeper than 8 feet are not anticipated at the site. Groundwater was not encountered within the depths explored, up to about 23 feet, at the time of our field explorations, and thus is not anticipated to be encountered in excavations.

The natural soils encountered at this site predominantly consisted of sand/gravel. For sandy/gravelly (cohesionless) soils, temporary construction excavations not exceeding 4 feet in depth should be no steeper than one-half horizontal to one vertical (0.5H:1V). For excavations up to 8 feet and above groundwater, side slopes should be no steeper than one horizontal to one vertical (1H:1V). Excavations encountering saturated cohesionless soils will be very difficult to maintain, and will require very flat side slopes and/or shoring, bracing and dewatering.

In clayey (cohesive) soils, temporary construction excavations not exceeding 4 feet in depth may be constructed with near-vertical side slopes. Temporary excavations up to 8 feet deep, above or below groundwater, may be constructed with side slopes no steeper than one-half horizontal to one vertical (0.5H:1V).

To reduce disturbance of the natural soils during excavation, we recommend that smooth edge buckets/blades be utilized.

All excavations must be inspected periodically by qualified personnel. If any signs of instability or excessive sloughing are noted, immediate remedial action must be initiated. All excavations should be made following OSHA safety guidelines.

6.3 Fill Material

Following are our recommendations for the various fill types we anticipate will be used at this site:

FILL MATERIAL TYPE	DESCRIPTION RECOMMENDED SPECIFICATION
Structural Fill	Placed below structures, flatwork and pavement. Well-graded sand/gravel mixture, with maximum particle size of 4 inches, a minimum 70% passing 3/4-inch sieve, a maximum 20% passing the No. 200 sieve, and a maximum Plasticity Index of 10.
Site Grading Fill	Placed over larger areas to raise the site grade. Sandy to gravelly soil, with a maximum particle size of 6 inches, a minimum 70% passing 3/4-inch sieve, and a maximum 50% passing No. 200 sieve.
Non-Structural Fill	Placed below non-structural areas, such as landscaping. On-site soils or imported soils, with a maximum particle size of 8 inches, including silt/clay soils not containing excessive amounts of degradable/organic material (see discussion below).
Stabilization Fill	Placed to stabilize soft areas prior to placing structural fill and/or site grading fill. Coarse angular gravels and cobbles 1 inch to 8 inches in size. May also use 1.5- to 2.0-inch gravel placed on stabilization fabric, such as Mirafi RS280i, or equivalent (see Section 6.6).

On-site sand and gravel soils may be suitable for use as structural fill, if processed to meet the requirements given above, and may also be used in site grading fill and non-structural fill areas (landscape).

All fill material should be approved by a CMT geotechnical engineer prior to placement.

6.4 Fill Placement and Compaction

The various types of compaction equipment available have their limitations as to the maximum lift thickness that can be compacted. For example, hand operated equipment is limited to lifts of about 4 inches and most “trench compactors” have a maximum, consistent compaction depth of about 6 inches. Large rollers, depending on soil and moisture conditions, can achieve compaction at 8 to 12 inches. The full thickness of each lift should be compacted to at least the following percentages of the maximum dry density as determined by ASTM D-1557 (or AASHTO⁷ T-180) in accordance with the following recommendations:

⁷ American Association of State Highway and Transportation Officials

LOCATION	TOTAL FILL THICKNESS (FEET)	MINIMUM PERCENTAGE OF MAXIMUM DRY DENSITY
Beneath an area extending at least 4 feet beyond the perimeter of structures, and below flatwork and pavement (applies to structural fill and site grading fill) extending at least 2 feet beyond the perimeter	0 to 5	95
	5 to 8	98
Site grading fill outside area defined above	0 to 5	92
	5 to 8	95
Utility trenches within structural areas	--	96
Roadbase and subbase	-	96
Non-structural fill	0 to 5	90
	5 to 8	92

Structural fills greater than 8 feet thick are not anticipated at the site. For best compaction results, we recommend that the moisture content for structural fill/backfill be within 2% of optimum. Field density tests should be performed on each lift as necessary to verify that proper compaction is being achieved.

6.5 Utility Trenches

For the bedding zone around the utility, we recommend utilizing sand bedding fill material that meets current APWA⁸ requirements.

All utility trench backfill material below structurally loaded facilities (foundations, floor slabs, flatwork, parking lots/drive areas, etc.) should be placed at the same density requirements established for structural fill in the previous section.

Most utility companies and local governments are requiring Type A-1a or A-1b (AASHTO Designation) soils (sand/gravel soils with limited fines) be used as backfill over utilities within public rights of way, and the backfill be compacted over the full depth above the bedding zone to at least 96% of the maximum dry density as determined by AASHTO T-180 (ASTM D-1557). Some of the natural sand and gravel soils at this site, and possibly some of the existing fill soils, may meet these specifications.

Where the utility does not underlie structurally loaded facilities and public rights of way, on-site fill and natural soils may be utilized as trench backfill above the bedding layer, provided they are properly moisture conditioned and compacted to the minimum requirements stated above in **Section 6.4**.

6.6 Stabilization

The likelihood of disturbance or rutting and/or pumping of the existing natural soils is a function of the load applied to the surface, as well as the frequency of the load. Consequently, rutting and pumping can be minimized by avoiding concentrated traffic, minimizing the load applied to the surface by using lighter

⁸ American Public Works Association

equipment and/or partial loads, by working in drier times of the year, or by providing a working surface for the equipment. Rubber-tired equipment particularly, because of high pressures, promotes instability in moist/wet, soft soils.

If rutting or pumping occurs, traffic should be stopped and the disturbed soils should be removed and replaced with stabilization material. Typically, a minimum of 18 inches of the disturbed soils must be removed to be effective. However, deeper removal is sometimes required.

To stabilize soft subgrade conditions (if encountered), a mixture of coarse, clean, angular gravels and cobbles and/or 1.5- to 2.0-inch clean gravel should be utilized. Often the amount of gravelly material can be reduced with the use of a geotextile fabric such as Mirafi RS280i, or equivalent. Its use will also help avoid mixing of the subgrade soils with the gravelly material. After excavating the soft/disturbed soils, the fabric should be spread across the bottom of the excavation and up the sides a minimum of 18 inches. Otherwise, it should be placed in accordance with the manufacturer's recommendation, including proper overlaps. The gravel material can then be placed over the fabric in compacted lifts as described above.

7.0 FOUNDATION RECOMMENDATIONS

The following recommendations have been developed on the basis of the previously described project characteristics, the subsurface conditions observed in the field and the laboratory test data, as well as common geotechnical engineering practice.

7.1 Foundation Recommendations

Based on our geotechnical engineering analyses, the proposed structure may be supported upon conventional spread and/or continuous wall foundations placed on suitable, undisturbed natural sand/gravel soils and/or on structural fill extending to suitable natural sand/gravel soils. Footings may be designed using a net bearing pressure of 2,500 psf.

The term "net bearing pressure" refers to the pressure imposed by the portion of the structure located above lowest adjacent final grade, thus the weight of the footing and backfill to lowest adjacent final grade need not be considered. The allowable bearing pressure may be increased by 1/3 for temporary loads such as wind and seismic forces.

We also recommend the following:

1. Exterior footings subject to frost should be placed at least 30 inches below final grade.
2. Interior footings not subject to frost should be placed at least 16 inches below grade.
3. Continuous footing widths should be maintained at a minimum of 18 inches.
4. Spot footings should be a minimum of 24 inches wide.

7.2 Installation

Under no circumstances shall foundations be placed on undocumented fill, topsoil with organics, sod, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water. If unsuitable soils are encountered, they must be completely removed and replaced with properly compacted structural fill. Deep, large roots may be encountered where trees and larger bushes are located or were previously located at the site; such large roots should be removed.

The base of footing excavations should be examined by a CMT geotechnical engineer to confirm that suitable bearing soils have been exposed.

All structural fill should meet the requirements for such, and should be placed and compacted in accordance with **Section 6** above. The width of structural replacement fill below footings should be equal to the width of the footing plus 1 foot for each foot of fill thickness. For instance, if the footing width is 2 feet and the structural fill depth beneath the footing is 2 feet, the fill replacement width should be 4 feet, centered beneath the footing.

The minimum thickness of structural fill below footings should be equivalent to one-third the thickness of structural fill below any other portion of the foundations. For example, if the maximum depth of structural fill is 6 feet, all footings for the new structure should be underlain by a minimum 2 feet of structural fill.

7.3 Estimated Settlement

Foundations designed and constructed in accordance with our recommendations could experience some settlement, but we anticipate that total settlements of footings founded as recommended above will not exceed 1 inch, with differential settlements on the order of 0.5 inches over a distance of 25 feet. We expect approximately 50% of the total settlement to initially take place during construction.

7.4 Lateral Resistance

Lateral loads imposed upon foundations due to wind or seismic forces may be resisted by the development of passive earth pressures and friction between the base of the footings and the supporting soils. In determining frictional resistance, a coefficient of 0.40 for natural sand/gravel soils and structural fill may be utilized for design. Passive resistance provided by properly placed and compacted structural fill above the water table may be considered equivalent to a fluid with a density of 425 pcf. A combination of passive earth resistance and friction may be utilized if the friction component of the total is divided by 1.5.

8.0 LATERAL EARTH PRESSURES

We project that basement walls up to 8 feet tall will be constructed at this site. The lateral earth pressure values given below anticipate that existing sand and gravel soils, native or fill, will be used as backfill material, placed and compacted in accordance with the recommendations presented herein. If other soil types will be used as backfill, we should be notified so that appropriate modifications to these values can be provided, as needed.

The lateral pressures imposed upon subgrade facilities will depend upon the relative rigidity and movement of the backfilled structure. Following are the recommended lateral pressure values, which also assume that the soil surface behind the wall is horizontal and that the backfill within 3 feet of the wall will be compacted with hand-operated compacting equipment.

CONDITION	STATIC (psf/ft)*	SEISMIC (psf)**
Active Pressure (wall is allowed to yield, i.e. move away from the soil, with a minimum 0.001H movement/rotation at the top of the wall, where "H" is the total height of the wall)	35	120
At-Rest Pressure (wall is not allowed to yield)	55	320
Passive Pressure (wall moves into the soil)	425	725

*Equivalent Fluid Pressure (applied at 1/3 Height of 8-foot High Wall)

**Uniform Pressure, Seismic Only (applied at 1/2 Height of 8-foot High Wall)

9.0 FLOOR SLABS

Floor slabs may be established upon suitable, undisturbed, natural soils and/or on structural fill extending to suitable natural soils (same as for foundations). Under no circumstances shall floor slabs be established directly on any topsoil, undocumented fills, loose or disturbed soils, sod, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water.

In order to facilitate curing of the concrete, we recommend that floor slabs be directly underlain by at least 4 inches of "free-draining" fill, such as "pea" gravel or 3/4-inch quarters to 1-inch minus, clean, gap-graded gravel. To help control normal shrinkage and stress cracking, the floor slabs should have the following features:

1. Adequate reinforcement for the anticipated floor loads with the reinforcement continuous through interior floor joints;
2. Frequent crack control joints; and
3. Non-rigid attachment of the slabs to foundation walls and bearing slabs.

10.0 DRAINAGE RECOMMENDATIONS

It is important to the long-term performance of foundations and floor slabs that water not be allowed to collect near the foundation walls and infiltrate into the underlying soils. We recommend the following:

1. All areas around the structure should be sloped to provide drainage away from the foundations. We recommend a minimum slope of 4 inches in the first 10 feet away from the structure. This slope should be maintained throughout the lifetime of the structure.
2. All roof drainage should be collected in rain gutters with downspouts designed to discharge at least 10 feet from the foundation walls or well beyond the backfill limits, whichever is greater.

3. Adequate compaction of the foundation backfill should be provided. We suggest a minimum of 90% of the maximum laboratory density as determined by ASTM D-1557. Water consolidation methods should not be used under any circumstances.
4. Landscape sprinklers should be aimed away from the foundation walls. The sprinkling systems should be designed with proper drainage and be well-maintained. Over watering should be avoided.
5. Other precautions that may become evident during construction.

11.0 PAVEMENTS

All pavement areas must be prepared as discussed above in **Section 6.1**. Under no circumstances shall pavements be established over topsoil, unprepared undocumented fill soils, loose or disturbed soils, sod, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water.

In roadway areas, subsequent to stripping and prior to the placement of pavement materials, the exposed subgrade must be proof rolled by passing moderate-weight rubber tire-mounted construction equipment over the surface at least twice. If excessively soft or otherwise unsuitable soils are encountered, we recommend they be removed to a minimum of 18 inches below the subgrade level and replaced with structural fill.

We anticipate the natural sand and gravel soils, or the properly prepared sand and gravel fill soils, will exhibit good pavement support characteristics when saturated or nearly saturated, although some settlement could occur in areas where undocumented fills remain below the pavements. Based on our laboratory testing experience with similar soils, our pavement design is based upon a California Bearing Ratio (CBR) of 10. Given the projected traffic as discussed above in **Section 1.3**, the following pavement sections are recommended for the given ESAL's (18-kip equivalent single-axle loads) per day:

MATERIAL	PAVEMENT SECTION THICKNESS (inches)					
	PARKING AREAS (3 ESAL's per day)			DRIVE AREAS (8 ESAL'S per day)		
Asphalt	3	3	---	3.5	3.5	---
Concrete	---	--	5	---	---	6
Road-Base	8	4	5	10	6	6
Subbase	0	6	0	0	6	0
Total Thickness	11	13	10	13.5	15.5	12

Untreated base course (UTBC) should conform to city specifications, or to 1-inch-minus UDOT specifications for A-1-a/NP, and have a minimum CBR value of 70%. Material meeting our specification for structural fill can be used for subbase, as long as the fines content (percent passing No. 200 sieve) does not exceed 15%. Roadbase and subbase material should be compacted as recommended above in **Section 6.4**. Asphalt material generally should conform to APWA requirements, having a ½-inch maximum aggregate size, a 75-gradation Superpave mix containing no more than 15% of recycled asphalt (RAP) and a PG58-28 binder.

Concrete pavement should typically have a minimum 28-day strength of 3,000 psi, and should be saw-cut at appropriate intervals and at the proper time to control the locations of shrinkage cracking. This generally means maximum saw-cut intervals of twice the pavement thickness, in feet (i.e. a 10-foot maximum interval for 5 inches thick concrete), and performing the saw cutting within 24 hours of placement.

12.0 QUALITY CONTROL

We recommend that CMT be retained as part of a comprehensive quality control testing and observation program. With CMT onsite we can help facilitate implementation of our recommendations and address, in a timely manner, any subsurface conditions encountered which vary from those described in this report. Without such a program CMT cannot be responsible for application of our recommendations to subsurface conditions which may vary from those described herein. This program may include, but not necessarily be limited to, the following:

12.1 Field Observations

Observations should be completed during all phases of construction such as site preparation, foundation excavation, structural fill placement and concrete placement.

12.2 Fill Compaction

Compaction testing by CMT is required for all structural supporting fill materials. Maximum Dry Density (Modified Proctor, ASTM D-1557) tests should be requested by the contractor immediately after delivery of any fill materials. The maximum density information should then be used for field density tests on each lift as necessary to ensure that the required compaction is being achieved.

12.3 Excavations

All excavation procedures and processes should be observed by a geotechnical engineer from CMT or his representative. In addition, for the recommendations in this report to be valid, all backfill and structural fill placed in trenches and all pavements should be density tested by CMT. We recommend that freshly mixed concrete be tested by CMT in accordance with ASTM designations.

13.0 LIMITATIONS

The recommendations provided herein were developed by evaluating the information obtained from the subsurface explorations and soils encountered therein. The exploration logs reflect the subsurface conditions only at the specific location at the particular time designated on the logs. Soil and ground water conditions may differ from conditions encountered at the actual exploration locations. The nature and extent of any variation in the explorations may not become evident until during the course of construction. If variations do appear, it may become necessary to re-evaluate the recommendations of this report after we have observed the variation.

Geotechnical Engineering Study

Proposed East Layton Fire Station, Layton, Utah
CMT Project No. 14961

Our professional services have been performed, our findings obtained, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. This warranty is in lieu of all other warranties, either expressed or implied.

We appreciate the opportunity to be of service to you on this project. If we can be of further assistance or if you have any questions regarding this project, please do not hesitate to contact us at (801) 492-4132. To schedule materials testing, please call (801) 381-5141.

APPENDIX

SUPPORTING DOCUMENTATION



Proposed East Layton Fire Station

1100 North Valley View Drive, Layton, Utah

CMT ENGINEERING
LABORATORIES

Site Map

Date:	3-Aug-20
Job #	14961

Figure:

1

Proposed East Layton Fire Station

Bore Hole Log

B-1

1100 North Valley View Drive, Layton, Utah

Boring Type: **Hollow-Stem Auger**
 Surface Elev. (approx): **N/A**

Total Depth: **23'**
 Water Depth: **(see Remarks)**

Date: **7/29/20**
 Job #: **14961**

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Blows (N)		Moisture (%)	Dry Density(pcf)	Gradation			Atterberg		
					Total				Gravel %	Sand %	Fines %	LL	PL	PI
0		Fill: Reddish-brown silty clayey sand with gravel and cobbles												
0-4		Reddish-Brown Silty GRAVEL (GM), with occasional sand layers, slightly moist POSSIBLE FILL?												
4		medium dense		1	6 8 6	14								
4-8		very dense		2	50/2"	3				18				
8		Reddish-brown Silty SAND (SM) with gravel, layered, slightly moist												
8-12		grades with more sand												
12		medium dense		3	4 5 7	12	9		16	54	30		NP	NP
12-16														
16				4	3 5 7	12								
16-20		Reddish-Brown Silty GRAVEL (GM) with cobbles, slightly moist												
20		grades with some clay												
20		medium dense		5	5 8 20	28	7				26			
20-24														
24		REFUSAL AT 23.0 FEET		6	20 50/0"	50+								
24-28														

Remarks: **Groundwater not encountered during drilling.**

Figure:

Proposed East Layton Fire Station

Bore Hole Log

B-2

1100 North Valley View Drive, Layton, Utah

Boring Type: **Hollow-Stem Auger**
 Surface Elev. (approx): **N/A**

Total Depth: **7.5'**
 Water Depth: **(see Remarks)**

Date: **7/29/20**
 Job #: **14961**

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Blows (N)		Moisture (%)	Dry Density(pcf)	Gradation			Atterberg		
						Total			Gravel %	Sand %	Fines %	LL	PL	PI
0		Fill: Red-brown sand and gravel with silt and clay												
4		Reddish-Brown Clayey to Sandy GRAVEL (GC) with cobbles, slightly moist dense		7	6 9 6	15								
				8	5 6 24	30	8			22				
8		REFUSAL AT 7.5 FEET		9	40 50/2"	50+								
12														
16														
20														
24														
28														

Remarks: Groundwater not encountered during drilling.

Figure:

Proposed East Layton Fire Station

Bore Hole Log

B-3

1100 North Valley View Drive, Layton, Utah

Boring Type: **Hollow-Stem Auger**
 Surface Elev. (approx): **N/A**

Total Depth: **16.5'**
 Water Depth: **(see Remarks)**

Date: **7/29/20**
 Job #: **14961**

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Blows (N)		Moisture (%)	Dry Density(pcf)	Gradation			Atterberg				
					Total				Gravel %	Sand %	Fines %	LL	PL	PI		
0		Fill: Reddish-brown sandy clayey gravel and silty sand														
		Dark Brown Clayey GRAVEL (GC), slightly moist														
		POSSIBLE FILL? medium dense														
4		Brown Sandy CLAY (CL) with fine gravel, slightly moist														
		medium stiff														
		Reddish-Brown Silty SAND (SM) with gravel, layered, occasional cobbles, slightly moist														
		medium dense														
8																
		grades with layers of sandy silt 4" thick														
12																
16																
		END AT 16.5 FEET														
20																
24																
28																

Remarks: **Groundwater not encountered during drilling.**

Figure:

Proposed East Layton Fire Station

Bore Hole Log

B-4

1100 North Valley View Drive, Layton, Utah

Boring Type: Hollow-Stem Auger
 Surface Elev. (approx): N/A

Total Depth: 5'
 Water Depth: (see Remarks)

Date: 7/29/20
 Job #: 14961

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Blows (N)			Moisture (%)	Dry Density(pcf)	Gradation			Atterberg		
					Total					Gravel %	Sand %	Fines %	LL	PL	PI
0		Fill: Red-brown silty sand with gravel													
4		grades brown		15											
		END AT 5.0 FEET		16			8		31	42	27				
8															
12															
16															
20															
24															
28															

Remarks: Groundwater not encountered during drilling.

Figure:

Proposed East Layton Fire Station

Bore Hole Log

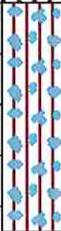
B-5

1100 North Valley View Drive, Layton, Utah

Boring Type: **Hollow-Stem Auger**
 Surface Elev. (approx): **N/A**

Total Depth: **6.5'**
 Water Depth: **(see Remarks)**

Date: **7/29/20**
 Job #: **14961**

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Blows (N)		Moisture (%)	Dry Density(pcf)	Gradation			Atterberg		
					Total				Gravel %	Sand %	Fines %	LL	PL	PI
0		Fill: Brown silty sand with occasional gravel												
4		Reddish Brown Silty GRAVEL (GM) with sand, layered, slightly moist		17										
		loose		18	3 3 4	7								
		END AT 6.5 FEET												
8														
12														
16														
20														
24														
28														

Remarks: Groundwater not encountered during drilling.

Figure:

Proposed East Layton Fire Station

Bore Hole Log

B-6

1100 North Valley View Drive, Layton, Utah

Boring Type: Hollow-Stem Auger
 Surface Elev. (approx): N/A

Total Depth: 5.5'
 Water Depth: (see Remarks)

Date: 7/29/20
 Job #: 14961

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Blows (N)		Moisture (%)	Dry Density (pcf)	Gradation			Atterberg		
					Total				Gravel %	Sand %	Fines %	LL	PL	PI
0		Fill: Gray silt sand with gravel and cobbles		19	4	7	11		4	67	29			
					3									
4					4									
		END AT 5.5 FEET		20	18	50+								
					50/2"									
8														
12														
16														
20														
24														
28														

Remarks: Groundwater not encountered during drilling.

Figure:

7

Proposed East Layton Fire Station

Bore Hole Log

B-7

1100 North Valley View Drive, Layton, Utah

Boring Type: Hollow-Stem Auger
 Surface Elev. (approx): N/A

Total Depth: 5'
 Water Depth: (see Remarks)

Date: 7/29/20
 Job #: 14961

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Blows (N)		Moisture (%)	Dry Density (pcf)	Gradation			Atterberg		
						Total			Gravel %	Sand %	Fines %	LL	PL	PI
0		Fill: Reddish-brown silty sand with some clay												
4		Reddish-Brown GRAVEL (GP) with sand, slightly moist POSSIBLE FILL?		21	3 3 3	6								
		END AT 5.0 FEET		22	50/1"	50+								
8														
12														
16														
20														
24														
28														

Remarks: Groundwater not encountered during drilling.

Figure:

Proposed Layton Fire Station

1100 North Valley View Drive, Layton, Utah

Key to Symbols

Date: 7/29/20

Job #: 14961

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Blows(N)	Moisture (%)	Dry Density(pcf)	Gradation			Atterberg		
								Gravel %	Sand %	Fines %	LL	PL	PI
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪			
COLUMN DESCRIPTIONS													
①	① Depth (ft.): Depth (feet) below the ground surface (including groundwater depth - see water symbol below).			⑩	⑩ Gradation: Percentages of Gravel, Sand and Fines (Silt/Clay), obtained from lab test results of soil passing the No. 4 and No. 200 sieves.								
②	② Graphic Log: Graphic depicting type of soil encountered (see ② below).			⑪	⑪ Atterberg: Individual descriptions of Atterberg Tests are as follows:								
③	③ Soil Description: Description of soils encountered, including Unified Soil Classification Symbol (see below).				LL = Liquid Limit (%): Water content at which a soil changes from plastic to liquid behavior. PL = Plastic Limit (%): Water content at which a soil changes from liquid to plastic behavior. PI = Plasticity Index (%): Range of water content at which a soil exhibits plastic properties (= Liquid Limit - Plastic Limit).								
④	④ Sample Type: Type of soil sample collected at depth interval shown; sampler symbols are explained below-right.												
⑤	⑤ Sample #: Consecutive numbering of soil samples collected during field exploration.												
⑥	⑥ Blows: Number of blows to advance sampler in 6" increments, using a 140-lb hammer with 30" drop.												
⑦	⑦ Total Blows: Number of blows to advance sampler the 2nd and 3rd 6" increments.												
⑧	⑧ Moisture (%): Water content of soil sample measured in laboratory (percentage of dry weight of sample).												
⑨	⑨ Dry Density (pcf): The dry density of a soil measured in laboratory (pounds per cubic foot).												

STRATIFICATION		MODIFIERS	MOISTURE CONTENT
Description	Thickness	Trace	Dry: Absence of moisture, dusty, dry to the touch.
Seam	Up to ½ inch	<5%	Moist: Damp / moist to the touch, but no visible water.
Lense	Up to 12 inches	Some	5-12%
Layer	Greater than 12 in.	With	Saturated: Visible water, usually soil below groundwater.
Occasional	1 or less per foot		
Frequent	More than 1 per foot	> 12%	

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)	MAJOR DIVISIONS		USCS SYMBOLS	②	TYPICAL DESCRIPTIONS
	COARSE-GRAINED SOILS More than 50% of material is larger than No. 200 sieve size.	GRAVELS The coarse fraction retained on No. 4 sieve.	CLEAN GRAVELS	GW	
(< 5% fines)			GP		Poorly-Graded Gravels, Gravel-Sand Mixtures, Little or No Fines
GRAVELS WITH FINES			GM		Silty Gravels, Gravel-Sand-Silt Mixtures
			(≥ 12% fines)	GC	
SANDS The coarse fraction passing through No. 4 sieve.		CLEAN SANDS	SW		Well-Graded Sands, Gravelly Sands, Little or No Fines
		(< 5% fines)	SP		Poorly-Graded Sands, Gravelly Sands, Little or No Fines
	SANDS WITH FINES	SM		Silty Sands, Sand-Silt Mixtures	
(≥ 12% fines)		SC		Clayey Sands, Sand-Clay Mixtures	
FINE-GRAINED SOILS More than 50% of material is smaller than No. 200 sieve size.	SILTS AND CLAYS Liquid Limit less than 50%		ML		Inorganic Silts and Very Fine Sands, Silty or Clayey Fine Sands or Clayey Silts with Slight Plasticity
			CL		Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays
			OL		Organic Silts and Organic Silty Clays of Low Plasticity
	SILTS AND CLAYS Liquid Limit greater than 50%		MH		Inorganic Silts, Micaceous or Diatomaceous Fine Sand or Silty Soils with Plasticity (Elastic Silts)
			CH		Inorganic Clays of High Plasticity, Fat Clays
			OH		Organic Silts and Organic Clays of Medium to High Plasticity
HIGHLY ORGANIC SOILS			PT		Peat, Humus, Swamp Soils with High Organic Contents

SAMPLER SYMBOLS	
	Block Sample
	Bulk/Bag Sample
	Modified California Sampler
	3.5" OD, 2.42" ID D&M Sampler
	Rock Core
	Standard Penetration Split Spoon Sampler
	Thin Wall (Shelby Tube)

WATER SYMBOL	
	Encountered Water Level
	Measured Water Level
(see Remarks on Logs)	

Note: Dual Symbols are used to indicate borderline soil classifications (i.e. GP-GM, SC-SM, etc.).

- The results of laboratory tests on the samples collected are shown on the logs at the respective sample depths.
- The subsurface conditions represented on the logs are for the locations specified. Caution should be exercised if interpolating between or extrapolating beyond the exploration locations.
- The information presented on each log is subject to the limitations, conclusions, and recommendations presented in this report.

Figure:

AIA[®] Document A101[®] – 2017 Exhibit A

Insurance and Bonds

This Insurance and Bonds Exhibit is part of the Agreement, between the Owner and the Contractor, dated the Thirteenth day of March in the year Two Thousand Twenty
(In words, indicate day, month and year.)

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

Layton City Fire Station 54
Layton, Utah

THE OWNER:
(Name, legal status and address)

Layton City, General Corporation
437 North Wasatch Drive
Layton, Utah 84041

THE CONTRACTOR:
(Name, legal status and address)

To be determined

TABLE OF ARTICLES

- A.1 GENERAL
- A.2 OWNER'S INSURANCE
- A.3 CONTRACTOR'S INSURANCE AND BONDS
- A.4 SPECIAL TERMS AND CONDITIONS

ARTICLE A.1 GENERAL

The Owner and Contractor shall purchase and maintain insurance, and provide bonds, as set forth in this Exhibit. As used in this Exhibit, the term General Conditions refers to AIA Document A201TM-2017, General Conditions of the Contract for Construction.

ARTICLE A.2 OWNER'S INSURANCE

§ A.2.1 General

Prior to commencement of the Work, the Owner shall secure the insurance, and provide evidence of the coverage, required under this Article A.2 and, upon the Contractor's request, provide a copy of the property insurance policy or policies required by Section A.2.3. The copy of the policy or policies provided shall contain all applicable conditions, definitions, exclusions, and endorsements.

§ A.2.2 Liability Insurance

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

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.

This document is intended to be used in conjunction with AIA Document A201[®]-2017, General Conditions of the Contract for Construction. Article 11 of A201[®]-2017 contains additional insurance provisions.

§ A.2.3 Required Property Insurance

§ A.2.3.1 Unless this obligation is placed on the Contractor pursuant to Section A.3.3.2.1, the Owner shall purchase and maintain, from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located, property insurance written on a builder's risk "all-risks" completed value or equivalent policy form and sufficient to cover the total value of the entire Project on a replacement cost basis. The Owner's property insurance coverage shall be no less than the amount of the initial Contract Sum, plus the value of subsequent Modifications and labor performed and materials or equipment supplied by others. The property insurance shall be maintained until Substantial Completion and thereafter as provided in Section A.2.3.1.3, unless otherwise provided in the Contract Documents or otherwise agreed in writing by the parties to this Agreement. This insurance shall include the interests of the Owner, Contractor, Subcontractors, and Sub-subcontractors in the Project as insureds. This insurance shall include the interests of mortgagees as loss payees.

§ A.2.3.1.1 Causes of Loss. The insurance required by this Section A.2.3.1 shall provide coverage for direct physical loss or damage, and shall not exclude the risks of fire, explosion, theft, vandalism, malicious mischief, collapse, earthquake, flood, or windstorm. The insurance shall also provide coverage for ensuing loss or resulting damage from error, omission, or deficiency in construction methods, design, specifications, workmanship, or materials. Sub-limits, if any, are as follows:

(Indicate below the cause of loss and any applicable sub-limit.)

Causes of Loss	Sub-Limit
----------------	-----------

§ A.2.3.1.2 Specific Required Coverages. The insurance required by this Section A.2.3.1 shall provide coverage for loss or damage to falsework and other temporary structures, and to building systems from testing and startup. The insurance shall also cover debris removal, including demolition occasioned by enforcement of any applicable legal requirements, and reasonable compensation for the Architect's and Contractor's services and expenses required as a result of such insured loss, including claim preparation expenses. Sub-limits, if any, are as follows:

(Indicate below type of coverage and any applicable sub-limit for specific required coverages.)

Coverage	Sub-Limit
----------	-----------

§ A.2.3.1.3 Unless the parties agree otherwise, upon Substantial Completion, the Owner shall continue the insurance required by Section A.2.3.1 or, if necessary, replace the insurance policy required under Section A.2.3.1 with property insurance written for the total value of the Project that shall remain in effect until expiration of the period for correction of the Work set forth in Section 12.2.2 of the General Conditions.

§ A.2.3.1.4 Deductibles and Self-Insured Retentions. If the insurance required by this Section A.2.3 is subject to deductibles or self-insured retentions, the Owner shall be responsible for all loss not covered because of such deductibles or retentions.

§ A.2.3.2 Occupancy or Use Prior to Substantial Completion. The Owner's occupancy or use of any completed or partially completed portion of the Work prior to Substantial Completion shall not commence until the insurance company or companies providing the insurance under Section A.2.3.1 have consented in writing to the continuance of coverage. The Owner and the Contractor shall take no action with respect to partial occupancy or use that would cause cancellation, lapse, or reduction of insurance, unless they agree otherwise in writing.

§ A.2.3.3 Insurance for Existing Structures

If the Work involves remodeling an existing structure or constructing an addition to an existing structure, the Owner shall purchase and maintain, until the expiration of the period for correction of Work as set forth in Section 12.2.2 of the General Conditions, "all-risks" property insurance, on a replacement cost basis, protecting the existing structure against direct physical loss or damage from the causes of loss identified in Section A.2.3.1, notwithstanding the undertaking of the Work. The Owner shall be responsible for all co-insurance penalties.

§ A.2.4 Optional Extended Property Insurance.

The Owner shall purchase and maintain the insurance selected and described below.

(Select the types of insurance the Owner is required to purchase and maintain by placing an X in the box(es) next to the description(s) of selected insurance. For each type of insurance selected, indicate applicable limits of coverage or other conditions in the fill point below the selected item.)

- § **A.2.4.1 Loss of Use, Business Interruption, and Delay in Completion Insurance**, to reimburse the Owner for loss of use of the Owner's property, or the inability to conduct normal operations due to a covered cause of loss.

- § **A.2.4.2 Ordinance or Law Insurance**, for the reasonable and necessary costs to satisfy the minimum requirements of the enforcement of any law or ordinance regulating the demolition, construction, repair, replacement or use of the Project.

- § **A.2.4.3 Expediting Cost Insurance**, for the reasonable and necessary costs for the temporary repair of damage to insured property, and to expedite the permanent repair or replacement of the damaged property.

- § **A.2.4.4 Extra Expense Insurance**, to provide reimbursement of the reasonable and necessary excess costs incurred during the period of restoration or repair of the damaged property that are over and above the total costs that would normally have been incurred during the same period of time had no loss or damage occurred.

- § **A.2.4.5 Civil Authority Insurance**, for losses or costs arising from an order of a civil authority prohibiting access to the Project, provided such order is the direct result of physical damage covered under the required property insurance.

- § **A.2.4.6 Ingress/Egress Insurance**, for loss due to the necessary interruption of the insured's business due to physical prevention of ingress to, or egress from, the Project as a direct result of physical damage.

- § **A.2.4.7 Soft Costs Insurance**, to reimburse the Owner for costs due to the delay of completion of the Work, arising out of physical loss or damage covered by the required property insurance: including construction loan fees; leasing and marketing expenses; additional fees, including those of architects, engineers, consultants, attorneys and accountants, needed for the completion of the construction, repairs, or reconstruction; and carrying costs such as property taxes, building permits, additional interest on loans, realty taxes, and insurance premiums over and above normal expenses.

§ A.2.5 Other Optional Insurance.

The Owner shall purchase and maintain the insurance selected below.

(Select the types of insurance the Owner is required to purchase and maintain by placing an X in the box(es) next to the description(s) of selected insurance.)

- § **A.2.5.1 Cyber Security Insurance** for loss to the Owner due to data security and privacy breach,

Init.

/

including costs of investigating a potential or actual breach of confidential or private information.
(Indicate applicable limits of coverage or other conditions in the fill point below.)

[] § A.2.5.2 Other Insurance
(List below any other insurance coverage to be provided by the Owner and any applicable limits.)

Coverage	Limits
----------	--------

ARTICLE A.3 CONTRACTOR'S INSURANCE AND BONDS

§ A.3.1 General

§ A.3.1.1 Certificates of Insurance. The Contractor shall provide certificates of insurance acceptable to the Owner evidencing compliance with the requirements in this Article A.3 at the following times: (1) prior to commencement of the Work; (2) upon renewal or replacement of each required policy of insurance; and (3) upon the Owner's written request. An additional certificate evidencing continuation of commercial liability coverage, including coverage for completed operations, shall be submitted with the final Application for Payment and thereafter upon renewal or replacement of such coverage until the expiration of the periods required by Section A.3.2.1 and Section A.3.3.1. The certificates will show the Owner as an additional insured on the Contractor's Commercial General Liability and excess or umbrella liability policy or policies.

§ A.3.1.2 Deductibles and Self-Insured Retentions. The Contractor shall disclose to the Owner any deductible or self-insured retentions applicable to any insurance required to be provided by the Contractor.

§ A.3.1.3 Additional Insured Obligations. To the fullest extent permitted by law, the Contractor shall cause the commercial general liability coverage to include (1) the Owner, the Architect, and the Architect's consultants as additional insureds for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's operations; and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions for which loss occurs during completed operations. The additional insured coverage shall be primary and non-contributory to any of the Owner's general liability insurance policies and shall apply to both ongoing and completed operations. To the extent commercially available, the additional insured coverage shall be no less than that provided by Insurance Services Office, Inc. (ISO) forms CG 20 10 07 04, CG 20 37 07 04, and, with respect to the Architect and the Architect's consultants, CG 20 32 07 04.

§ A.3.2 Contractor's Required Insurance Coverage

§ A.3.2.1 The Contractor shall purchase and maintain the following types and limits of insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Contractor shall maintain the required insurance until the expiration of the period for correction of Work as set forth in Section 12.2.2 of the General Conditions, unless a different duration is stated below:

(If the Contractor is required to maintain insurance for a duration other than the expiration of the period for correction of Work, state the duration.)

§ A.3.2.2 Commercial General Liability

§ A.3.2.2.1 Commercial General Liability insurance for the Project written on an occurrence form with policy limits of not less than (\$) each occurrence, (\$) general aggregate, and (\$) aggregate for products-completed operations hazard, providing coverage for claims including

- .1 damages because of bodily injury, sickness or disease, including occupational sickness or disease, and death of any person;
- .2 personal injury and advertising injury;
- .3 damages because of physical damage to or destruction of tangible property, including the loss of use of such property;
- .4 bodily injury or property damage arising out of completed operations; and
- .5 the Contractor's indemnity obligations under Section 3.18 of the General Conditions.

§ A.3.2.2.2 The Contractor's Commercial General Liability policy under this Section A.3.2.2 shall not contain an exclusion or restriction of coverage for the following:

- .1 Claims by one insured against another insured, if the exclusion or restriction is based solely on the fact that the claimant is an insured, and there would otherwise be coverage for the claim.
- .2 Claims for property damage to the Contractor's Work arising out of the products-completed operations hazard where the damaged Work or the Work out of which the damage arises was performed by a Subcontractor.
- .3 Claims for bodily injury other than to employees of the insured.
- .4 Claims for indemnity under Section 3.18 of the General Conditions arising out of injury to employees of the insured.
- .5 Claims or loss excluded under a prior work endorsement or other similar exclusionary language.
- .6 Claims or loss due to physical damage under a prior injury endorsement or similar exclusionary language.
- .7 Claims related to residential, multi-family, or other habitational projects, if the Work is to be performed on such a project.
- .8 Claims related to roofing, if the Work involves roofing.
- .9 Claims related to exterior insulation finish systems (EIFS), synthetic stucco or similar exterior coatings or surfaces, if the Work involves such coatings or surfaces.
- .10 Claims related to earth subsidence or movement, where the Work involves such hazards.
- .11 Claims related to explosion, collapse and underground hazards, where the Work involves such hazards.

§ A.3.2.3 Automobile Liability covering vehicles owned, and non-owned vehicles used, by the Contractor, with policy limits of not less than (\$) per accident, for bodily injury, death of any person, and property damage arising out of the ownership, maintenance and use of those motor vehicles along with any other statutorily required automobile coverage.

§ A.3.2.4 The Contractor may achieve the required limits and coverage for Commercial General Liability and Automobile Liability through a combination of primary and excess or umbrella liability insurance, provided such primary and excess or umbrella insurance policies result in the same or greater coverage as the coverages required under Section A.3.2.2 and A.3.2.3, and in no event shall any excess or umbrella liability insurance provide narrower coverage than the primary policy. The excess policy shall not require the exhaustion of the underlying limits only through the actual payment by the underlying insurers.

§ A.3.2.5 Workers' Compensation at statutory limits.

§ A.3.2.6 Employers' Liability with policy limits not less than (\$) each accident, (\$) each employee, and (\$) policy limit.

§ A.3.2.7 Jones Act, and the Longshore & Harbor Workers' Compensation Act, as required, if the Work involves hazards arising from work on or near navigable waterways, including vessels and docks

§ A.3.2.8 If the Contractor is required to furnish professional services as part of the Work, the Contractor shall procure Professional Liability insurance covering performance of the professional services, with policy limits of not less than (\$) per claim and (\$) in the aggregate.

§ A.3.2.9 If the Work involves the transport, dissemination, use, or release of pollutants, the Contractor shall procure Pollution Liability insurance, with policy limits of not less than (\$) per claim and (\$) in the aggregate.

§ A.3.2.10 Coverage under Sections A.3.2.8 and A.3.2.9 may be procured through a Combined Professional Liability and Pollution Liability insurance policy, with combined policy limits of not less than (\$) per claim and (\$) in the aggregate.

§ A.3.2.11 Insurance for maritime liability risks associated with the operation of a vessel, if the Work requires such activities, with policy limits of not less than (\$) per claim and (\$) in the aggregate.

§ A.3.2.12 Insurance for the use or operation of manned or unmanned aircraft, if the Work requires such activities, with policy limits of not less than (\$) per claim and (\$) in the aggregate.

§ A.3.3 Contractor's Other Insurance Coverage

§ A.3.3.1 Insurance selected and described in this Section A.3.3 shall be purchased from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Contractor shall maintain the required insurance until the expiration of the period for correction of Work as set forth in Section 12.2.2 of the General Conditions, unless a different duration is stated below:

(If the Contractor is required to maintain any of the types of insurance selected below for a duration other than the expiration of the period for correction of Work, state the duration.)

§ A.3.3.2 The Contractor shall purchase and maintain the following types and limits of insurance in accordance with Section A.3.3.1.

(Select the types of insurance the Contractor is required to purchase and maintain by placing an X in the box(es) next to the description(s) of selected insurance. Where policy limits are provided, include the policy limit in the appropriate fill point.)

§ A.3.3.2.1 Property insurance of the same type and scope satisfying the requirements identified in Section A.2.3, which, if selected in this section A.3.3.2.1, relieves the Owner of the responsibility to purchase and maintain such insurance except insurance required by Section A.2.3.1.3 and Section A.2.3.3. The Contractor shall comply with all obligations of the Owner under Section A.2.3 except to the extent provided below. The Contractor shall disclose to the Owner the amount of any deductible, and the Owner shall be responsible for losses within the deductible. Upon request, the Contractor shall provide the Owner with a copy of the property insurance policy or policies required. The Owner shall adjust and settle the loss with the insurer and be the trustee of the proceeds of the property insurance in accordance with Article 11 of the General Conditions unless otherwise set forth below:

(Where the Contractor's obligation to provide property insurance differs from the Owner's obligations as described under Section A.2.3, indicate such differences in the space below. Additionally, if a party other than the Owner will be responsible for adjusting and settling a loss with the insurer and acting as the trustee of the proceeds of property insurance in accordance with Article 11 of the General Conditions, indicate the responsible party below.)

§ A.3.3.2.2 Railroad Protective Liability Insurance, with policy limits of not less than (\$) per claim and (\$) in the aggregate, for Work within fifty (50) feet of railroad property.

§ A.3.3.2.3 Asbestos Abatement Liability Insurance, with policy limits of not less than (\$) per claim and (\$) in the aggregate, for liability arising from the encapsulation, removal, handling, storage, transportation, and disposal of asbestos-containing materials.

§ A.3.3.2.4 Insurance for physical damage to property while it is in storage and in transit to the construction site on an "all-risks" completed value form.

§ A.3.3.2.5 Property insurance on an "all-risks" completed value form, covering property owned by the Contractor and used on the Project, including scaffolding and other equipment.

§ A.3.3.2.6 Other Insurance
(List below any other insurance coverage to be provided by the Contractor and any applicable limits.)

Coverage

Limits

§ A.3.4 Performance Bond and Payment Bond

The Contractor shall provide surety bonds, from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located, as follows:

(Specify type and penal sum of bonds.)

Type	Penal Sum (\$0.00)
Payment Bond	
Performance Bond	

Payment and Performance Bonds shall be AIA Document A312™, Payment Bond and Performance Bond, or contain provisions identical to AIA Document A312™, current as of the date of this Agreement.

ARTICLE A.4 SPECIAL TERMS AND CONDITIONS

Special terms and conditions that modify this Insurance and Bonds Exhibit, if any, are as follows:

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

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 13:58:55 MT on 11/18/2020.

PAGE 1

This Insurance and Bonds Exhibit is part of the Agreement, between the Owner and the Contractor, dated the Thirteenth day of March in the year Two Thousand Twenty

...

Layton City Fire Station 54
Layton, Utah

...

Layton City, General Corporation
437 North Wasatch Drive
Layton, Utah 84041

...

To be determined



AIA[®] Document A701[™] – 2018

Instructions to Bidders

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

Layton City Fire Station 54
Layton, Utah
New Fire Station for Layton City per City RFP and Architects Proposal

THE OWNER:
(Name, legal status, address, and other information)

Layton City, General Corporation
437 North Wasatch Drive
Layton, Utah 84041

THE ARCHITECT:
(Name, legal status, address, and other information)

Think Architecture, Inc., Subchapter S Corporation
7927 High Point Pkwy, Ste 300
Sandy, UT 84094
Telephone Number: (801) 269-0055
Fax Number: (801) 269-1425

TABLE OF ARTICLES

- 1 DEFINITIONS
- 2 BIDDER'S REPRESENTATIONS
- 3 BIDDING DOCUMENTS
- 4 BIDDING PROCEDURES
- 5 CONSIDERATION OF BIDS
- 6 POST-BID INFORMATION
- 7 PERFORMANCE BOND AND PAYMENT BOND
- 8 ENUMERATION OF THE PROPOSED CONTRACT DOCUMENTS

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.

FEDERAL, STATE, AND LOCAL LAWS MAY IMPOSE REQUIREMENTS ON PUBLIC PROCUREMENT CONTRACTS. CONSULT LOCAL AUTHORITIES OR AN ATTORNEY TO VERIFY REQUIREMENTS APPLICABLE TO THIS PROCUREMENT BEFORE COMPLETING THIS FORM.

It is intended that AIA Document G612[™]-2017, Owner's Instructions to the Architect, Parts A and B will be completed prior to using this document.

ARTICLE 1 DEFINITIONS

§ 1.1 Bidding Documents include the Bidding Requirements and the Proposed Contract Documents. The Bidding Requirements consist of the advertisement or invitation to bid, Instructions to Bidders, supplementary instructions to bidders, the bid form, and any other bidding forms. The Proposed Contract Documents consist of the unexecuted form of Agreement between the Owner and Contractor and that Agreement's Exhibits, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, all Addenda, and all other documents enumerated in Article 8 of these Instructions.

§ 1.2 Definitions set forth in the General Conditions of the Contract for Construction, or in other Proposed Contract Documents apply to the Bidding Documents.

§ 1.3 Addenda are written or graphic instruments issued by the Architect, which, by additions, deletions, clarifications, or corrections, modify or interpret the Bidding Documents.

§ 1.4 A Bid is a complete and properly executed proposal to do the Work for the sums stipulated therein, submitted in accordance with the Bidding Documents.

§ 1.5 The Base Bid is the sum stated in the Bid for which the Bidder offers to perform the Work described in the Bidding Documents, to which Work may be added or deleted by sums stated in Alternate Bids.

§ 1.6 An Alternate Bid (or Alternate) is an amount stated in the Bid to be added to or deducted from, or that does not change, the Base Bid if the corresponding change in the Work, as described in the Bidding Documents, is accepted.

§ 1.7 A Unit Price is an amount stated in the Bid as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, as described in the Bidding Documents.

§ 1.8 A Bidder is a person or entity who submits a Bid and who meets the requirements set forth in the Bidding Documents.

§ 1.9 A Sub-bidder is a person or entity who submits a bid to a Bidder for materials, equipment, or labor for a portion of the Work.

ARTICLE 2 BIDDER'S REPRESENTATIONS

§ 2.1 By submitting a Bid, the Bidder represents that:

- .1 the Bidder has read and understands the Bidding Documents;
- .2 the Bidder understands how the Bidding Documents relate to other portions of the Project, if any, being bid concurrently or presently under construction;
- .3 the Bid complies with the Bidding Documents;
- .4 the Bidder has visited the site, become familiar with local conditions under which the Work is to be performed, and has correlated the Bidder's observations with the requirements of the Proposed Contract Documents;
- .5 the Bid is based upon the materials, equipment, and systems required by the Bidding Documents without exception; and
- .6 the Bidder has read and understands the provisions for liquidated damages, if any, set forth in the form of Agreement between the Owner and Contractor.

ARTICLE 3 BIDDING DOCUMENTS

§ 3.1 Distribution

§ 3.1.1 Bidders shall obtain complete Bidding Documents, as indicated below, from the issuing office designated in the advertisement or invitation to bid, for the deposit sum, if any, stated therein.

(Indicate how, such as by email, website, host site/platform, paper copy, or other method Bidders shall obtain Bidding Documents.)

§ 3.1.2 Any required deposit shall be refunded to Bidders who submit a bona fide Bid and return the paper Bidding Documents in good condition within ten days after receipt of Bids. The cost to replace missing or damaged paper documents will be deducted from the deposit. A Bidder receiving a Contract award may retain the paper Bidding Documents, and the Bidder's deposit will be refunded.

§ 3.1.3 Bidding Documents will not be issued directly to Sub-bidders unless specifically offered in the advertisement or invitation to bid, or in supplementary instructions to bidders.

§ 3.1.4 Bidders shall use complete Bidding Documents in preparing Bids. Neither the Owner nor Architect assumes responsibility for errors or misinterpretations resulting from the use of incomplete Bidding Documents.

§ 3.1.5 The Bidding Documents will be available for the sole purpose of obtaining Bids on the Work. No license or grant of use is conferred by distribution of the Bidding Documents.

§ 3.2 Modification or Interpretation of Bidding Documents

§ 3.2.1 The Bidder shall carefully study the Bidding Documents, shall examine the site and local conditions, and shall notify the Architect of errors, inconsistencies, or ambiguities discovered and request clarification or interpretation pursuant to Section 3.2.2.

§ 3.2.2 Requests for clarification or interpretation of the Bidding Documents shall be submitted by the Bidder in writing and shall be received by the Architect at least seven days prior to the date for receipt of Bids.
(Indicate how, such as by email, website, host site/platform, paper copy, or other method Bidders shall submit requests for clarification and interpretation.)

§ 3.2.3 Modifications and interpretations of the Bidding Documents shall be made by Addendum. Modifications and interpretations of the Bidding Documents made in any other manner shall not be binding, and Bidders shall not rely upon them.

§ 3.3 Substitutions

§ 3.3.1 The materials, products, and equipment described in the Bidding Documents establish a standard of required function, dimension, appearance, and quality to be met by any proposed substitution.

§ 3.3.2 Substitution Process

§ 3.3.2.1 Written requests for substitutions shall be received by the Architect at least ten days prior to the date for receipt of Bids. Requests shall be submitted in the same manner as that established for submitting clarifications and interpretations in Section 3.2.2.

§ 3.3.2.2 Bidders shall submit substitution requests on a Substitution Request Form if one is provided in the Bidding Documents.

§ 3.3.2.3 If a Substitution Request Form is not provided, requests shall include (1) the name of the material or equipment specified in the Bidding Documents; (2) the reason for the requested substitution; (3) a complete description of the proposed substitution including the name of the material or equipment proposed as the substitute, performance and test data, and relevant drawings; and (4) any other information necessary for an evaluation. The request shall include a statement setting forth changes in other materials, equipment, or other portions of the Work, including changes in the work of other contracts or the impact on any Project Certifications (such as LEED), that will result from incorporation of the proposed substitution.

§ 3.3.3 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.

§ 3.3.4 If the Architect approves a proposed substitution prior to receipt of Bids, such approval shall be set forth in an Addendum. Approvals made in any other manner shall not be binding, and Bidders shall not rely upon them.

§ 3.3.5 No substitutions will be considered after the Contract award unless specifically provided for in the Contract Documents.

§ 3.4 Addenda

§ 3.4.1 Addenda will be transmitted to Bidders known by the issuing office to have received complete Bidding Documents.

(Indicate how, such as by email, website, host site/platform, paper copy, or other method Addenda will be transmitted.)

§ 3.4.2 Addenda will be available where Bidding Documents are on file.

§ 3.4.3 Addenda will be issued no later than four days prior to the date for receipt of Bids, except an Addendum withdrawing the request for Bids or one which includes postponement of the date for receipt of Bids.

§ 3.4.4 Prior to submitting a Bid, each Bidder shall ascertain that the Bidder has received all Addenda issued, and the Bidder shall acknowledge their receipt in the Bid.

ARTICLE 4 BIDDING PROCEDURES

§ 4.1 Preparation of Bids

§ 4.1.1 Bids shall be submitted on the forms included with or identified in the Bidding Documents.

§ 4.1.2 All blanks on the bid form shall be legibly executed. Paper bid forms shall be executed in a non-erasable medium.

§ 4.1.3 Sums shall be expressed in both words and numbers, unless noted otherwise on the bid form. In case of discrepancy, the amount entered in words shall govern.

§ 4.1.4 Edits to entries made on paper bid forms must be initialed by the signer of the Bid.

§ 4.1.5 All requested Alternates shall be bid. If no change in the Base Bid is required, enter "No Change" or as required by the bid form.

§ 4.1.6 Where two or more Bids for designated portions of the Work have been requested, the Bidder may, without forfeiture of the bid security, state the Bidder's refusal to accept award of less than the combination of Bids stipulated by the Bidder. The Bidder shall neither make additional stipulations on the bid form nor qualify the Bid in any other manner.

§ 4.1.7 Each copy of the Bid shall state the legal name and legal status of the Bidder. As part of the documentation submitted with the Bid, the Bidder shall provide evidence of its legal authority to perform the Work in the jurisdiction where the Project is located. Each copy of the Bid shall be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid by a corporation shall further name the state of incorporation and have the corporate seal affixed. A Bid submitted by an agent shall have a current power of attorney attached, certifying the agent's authority to bind the Bidder.

§ 4.1.8 A Bidder shall incur all costs associated with the preparation of its Bid.

§ 4.2 Bid Security

§ 4.2.1 Each Bid shall be accompanied by the following bid security:

(Insert the form and amount of bid security.)

None

§ 4.2.2 The Bidder pledges to enter into a Contract with the Owner on the terms stated in the Bid and shall, if required, furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder. Should the Bidder refuse to enter into such Contract or fail to furnish such bonds if required, the amount of the bid security shall be forfeited to the Owner as liquidated damages, not as a penalty. In the event the Owner fails to comply with Section 6.2, the amount of the bid security shall not be forfeited to the Owner.

§ 4.2.3 If a surety bond is required as bid security, it shall be written on AIA Document A310™, Bid Bond, unless otherwise provided in the Bidding Documents. The attorney-in-fact who executes the bond on behalf of the surety shall affix to the bond a certified and current copy of an acceptable power of attorney. The Bidder shall provide surety bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

§ 4.2.4 The Owner will have the right to retain the bid security of Bidders to whom an award is being considered until (a) the Contract has been executed and bonds, if required, have been furnished; (b) the specified time has elapsed so that Bids may be withdrawn; or (c) all Bids have been rejected. However, if no Contract has been awarded or a Bidder has not been notified of the acceptance of its Bid, a Bidder may, beginning days after the opening of Bids, withdraw its Bid and request the return of its bid security.

§ 4.3 Submission of Bids

§ 4.3.1 A Bidder shall submit its Bid as indicated below:

(Indicate how, such as by website, host site/platform, paper copy, or other method Bidders shall submit their Bid.)

§ 4.3.2 Paper copies of the Bid, the bid security, and any other documents required to be submitted with the Bid shall be enclosed in a sealed opaque envelope. The envelope shall be addressed to the party receiving the Bids and shall be identified with the Project name, the Bidder's name and address, and, if applicable, the designated portion of the Work for which the Bid is submitted. If the Bid is sent by mail, the sealed envelope shall be enclosed in a separate mailing envelope with the notation "SEALED BID ENCLOSED" on the face thereof.

§ 4.3.3 Bids shall be submitted by the date and time and at the place indicated in the invitation to bid. Bids submitted after the date and time for receipt of Bids, or at an incorrect place, will not be accepted.

§ 4.3.4 The Bidder shall assume full responsibility for timely delivery at the location designated for receipt of Bids.

§ 4.3.5 A Bid submitted by any method other than as provided in this Section 4.3 will not be accepted.

§ 4.4 Modification or Withdrawal of Bid

§ 4.4.1 Prior to the date and time designated for receipt of Bids, a Bidder may submit a new Bid to replace a Bid previously submitted, or withdraw its Bid entirely, by notice to the party designated to receive the Bids. Such notice shall be received and duly recorded by the receiving party on or before the date and time set for receipt of Bids. The receiving party shall verify that replaced or withdrawn Bids are removed from the other submitted Bids and not considered. Notice of submission of a replacement Bid or withdrawal of a Bid shall be worded so as not to reveal the amount of the original Bid.

§ 4.4.2 Withdrawn Bids may be resubmitted up to the date and time designated for the receipt of Bids in the same format as that established in Section 4.3, provided they fully conform with these Instructions to Bidders. Bid security shall be in an amount sufficient for the Bid as resubmitted.

§ 4.4.3 After the date and time designated for receipt of Bids, a Bidder who discovers that it made a clerical error in its Bid shall notify the Architect of such error within two days, or pursuant to a timeframe specified by the law of the jurisdiction where the Project is located, requesting withdrawal of its Bid. Upon providing evidence of such error to the reasonable satisfaction of the Architect, the Bid shall be withdrawn and not resubmitted. If a Bid is withdrawn pursuant to this Section 4.4.3, the bid security will be attended to as follows:

(State the terms and conditions, such as Bid rank, for returning or retaining the bid security.)

Per the instructions noted on website

ARTICLE 5 CONSIDERATION OF BIDS

§ 5.1 Opening of Bids

If stipulated in an advertisement or invitation to bid, or when otherwise required by law, Bids properly identified and received within the specified time limits will be publicly opened and read aloud. A summary of the Bids may be made available to Bidders.

§ 5.2 Rejection of Bids

Unless otherwise prohibited by law, the Owner shall have the right to reject any or all Bids.

§ 5.3 Acceptance of Bid (Award)

§ 5.3.1 It is the intent of the Owner to award a Contract to the lowest responsive and responsible Bidder, provided the Bid has been submitted in accordance with the requirements of the Bidding Documents. Unless otherwise prohibited by law, the Owner shall have the right to waive informalities and irregularities in a Bid received and to accept the Bid which, in the Owner's judgment, is in the Owner's best interests.

§ 5.3.2 Unless otherwise prohibited by law, the Owner shall have the right to accept Alternates in any order or combination, unless otherwise specifically provided in the Bidding Documents, and to determine the lowest responsive and responsible Bidder on the basis of the sum of the Base Bid and Alternates accepted.

ARTICLE 6 POST-BID INFORMATION

§ 6.1 Contractor's Qualification Statement

Bidders to whom award of a Contract is under consideration shall submit to the Architect, upon request and within the timeframe specified by the Architect, a properly executed AIA Document A305™, Contractor's Qualification Statement, unless such a Statement has been previously required and submitted for this Bid.

§ 6.2 Owner's Financial Capability

A Bidder to whom award of a Contract is under consideration may request in writing, fourteen days prior to the expiration of the time for withdrawal of Bids, that the Owner furnish to the Bidder reasonable evidence that financial arrangements have been made to fulfill the Owner's obligations under the Contract. The Owner shall then furnish such reasonable evidence to the Bidder no later than seven days prior to the expiration of the time for withdrawal of Bids. Unless such reasonable evidence is furnished within the allotted time, the Bidder will not be required to execute the Agreement between the Owner and Contractor.

§ 6.3 Submittals

§ 6.3.1 After notification of selection for the award of the Contract, the Bidder shall, as soon as practicable or as stipulated in the Bidding Documents, submit in writing to the Owner through the Architect:

- .1 a designation of the Work to be performed with the Bidder's own forces;
- .2 names of the principal products and systems proposed for the Work and the manufacturers and suppliers of each; and
- .3 names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for the principal portions of the Work.

§ 6.3.2 The Bidder will be required to establish to the satisfaction of the Architect and Owner the reliability and responsibility of the persons or entities proposed to furnish and perform the Work described in the Bidding Documents.

§ 6.3.3 Prior to the execution of the Contract, the Architect will notify the Bidder if either the Owner or Architect, after due investigation, has reasonable objection to a person or entity proposed by the Bidder. If the Owner or Architect has reasonable objection to a proposed person or entity, the Bidder may, at the Bidder's option, withdraw the Bid or submit an acceptable substitute person or entity. The Bidder may also submit any required adjustment in the Base Bid or Alternate Bid to account for the difference in cost occasioned by such substitution. The Owner may accept the adjusted bid price or disqualify the Bidder. In the event of either withdrawal or disqualification, bid security will not be forfeited.

§ 6.3.4 Persons and entities proposed by the Bidder and to whom the Owner and Architect have made no reasonable objection must be used on the Work for which they were proposed and shall not be changed except with the written consent of the Owner and Architect.

ARTICLE 7 PERFORMANCE BOND AND PAYMENT BOND

§ 7.1 Bond Requirements

§ 7.1.1 If stipulated in the Bidding Documents, the Bidder shall furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder.

§ 7.1.2 If the furnishing of such bonds is stipulated in the Bidding Documents, the cost shall be included in the Bid. If the furnishing of such bonds is required after receipt of bids and before execution of the Contract, the cost of such bonds shall be added to the Bid in determining the Contract Sum.

§ 7.1.3 The Bidder shall provide surety bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

§ 7.1.4 Unless otherwise indicated below, the Penal Sum of the Payment and Performance Bonds shall be the amount of the Contract Sum.

(If Payment or Performance Bonds are to be in an amount other than 100% of the Contract Sum, indicate the dollar amount or percentage of the Contract Sum.)

§ 7.2 Time of Delivery and Form of Bonds

§ 7.2.1 The Bidder shall deliver the required bonds to the Owner not later than three days following the date of execution of the Contract. If the Work is to commence sooner in response to a letter of intent, the Bidder shall, prior to commencement of the Work, submit evidence satisfactory to the Owner that such bonds will be furnished and delivered in accordance with this Section 7.2.1.

§ 7.2.2 Unless otherwise provided, the bonds shall be written on AIA Document A312, Performance Bond and Payment Bond.

§ 7.2.3 The bonds shall be dated on or after the date of the Contract.

§ 7.2.4 The Bidder shall require the attorney-in-fact who executes the required bonds on behalf of the surety to affix to the bond a certified and current copy of the power of attorney.

ARTICLE 8 ENUMERATION OF THE PROPOSED CONTRACT DOCUMENTS

§ 8.1 Copies of the proposed Contract Documents have been made available to the Bidder and consist of the following documents:

- .1 AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor, unless otherwise stated below.

(Paragraph deleted)

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

(Paragraph deleted)

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

(Paragraph deleted)

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

(Insert the date of the E203-2013.)

November 11, 2020

- .5 Drawings

Number	Title	Date
See Drawing Index in Architectural Drawings	Cover Sheet	November 11 th , 2020

- .6 Specifications

Section	Title	Date	Pages
See Specification Index in Project Manual	Project Manual Index	November 11, 2020	

.7 Addenda:

Number	Date	Pages
To Be Determined		

.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.)

The Sustainability Plan:

Title	Date	Pages

Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages

.9 Other documents listed below:

(List here any additional documents that are intended to form part of the Proposed Contract Documents.)

None

Additions and Deletions Report for

AIA® Document A701™ – 2018

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 14:04:07 MT on 11/18/2020.

PAGE 1

Layton City Fire Station 54
Layton, Utah
New Fire Station for Layton City per City RFP and Architects Proposal

...

Layton City, General Corporation
437 North Wasatch Drive
Layton, Utah 84041

...

Think Architecture, Inc., Subchapter S Corporation
7927 High Point Pkwy, Ste 300
Sandy, UT 84094
Telephone Number: (801) 269-0055
Fax Number: (801) 269-1425

PAGE 4

None

PAGE 5

Per the instructions noted on website

PAGE 7

(Insert the complete AIA Document number, including year, and Document title.)

...

- .2 AIA Document A101™–2017, Exhibit A, Insurance and Bonds, unless otherwise stated below.
(Insert the complete AIA Document number, including year, and Document title.)

...

- .3 AIA Document A201™–2017, General Conditions of the Contract for Construction, unless otherwise stated below.
(Insert the complete AIA Document number, including year, and Document title.)

...

November 11, 2020

...

See Drawing Index in Architectural Cover Sheet
Drawings

November 11th, 2020

PAGE 8

See Specification Index in Project Project Manual Index
Manual

November 11,
2020

...

To Be Determined

...

None

Certification of Document's Authenticity

AIA® Document D401™ – 2003

I, Corey R. Solum, AIA, 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 14:04:07 MT on 11/18/2020 under Order No. 8184578310 from AIA Contract Documents software and that in preparing the attached final document I made no changes to the original text of AIA® Document A701™ – 2018, Instructions to Bidders, as published by the AIA in its software, other than those additions and deletions shown in the associated Additions and Deletions Report.

(Signed)

(Title)

(Dated)

THINK Architecture - AGREEMENT FOR USE OF DIGITAL DATA



Date: November 11, 2020
Project Name and Location: Layton Fire Station #54
1100 North Valley View Drive, Layton, Utah
Client: Layton City
437 North Wasatch Drive, Layton, Utah
Think Architecture Job No: 20-015

- + Architecture
- + Landscape Architecture
- + Land Planning
- + Construction Management
- + Interior Design

THINK Architecture, Inc., has provided electronic files for the convenience and use in the preparation of drawings related to the above referenced project. By signing below, receiving and opening the electronic files, you hereby agreeing to the following terms and conditions:

Electronic files are compatible with THINK Architecture software and hardware. THINK Architecture makes no representation as to the compatibility of these files with other software or hardware. Requests to format, change or alter original files for the convenience of the person/ company request shall be an additional service, and shall be their responsibility of the person requesting the files to provide payment to THINK Architecture for changes requested.

Data contained on these electronic files is part of THINK's instrument of service, and are copyrighted by THINK Architecture. The electronic data shall not be used by anyone for any purpose other than as a convenience in the preparation of drawings for the referenced project. The information provided shall not be released to any other party without the written consent of THINK Architecture. Any use or reuse, by you or by others, will be at your sole risk and without liability or legal exposure to THINK Architecture. THINK Architecture hereby grants a limited use agreement of their copyright for the sole purpose of a convenience in the preparation of drawings for the referenced project. All other uses of the THINK Architecture electronic data are excluded from this limited use agreement and will be prosecuted to the fullest extent of the law.

THINK Architecture, Inc. makes no responsibility for viruses or other harmful hidden electronic files or data possibly included in the THINK Architecture electronic files. It is the responsibility of the Recipient to scan for and remove all viruses or potentially harmful data prior to use. THINK Architecture takes no responsibility for possible software errors that may affect the information or performance of the information included in these files.

The Recipient agrees to make no claim and hereby waives, to the fullest extent permitted by law, any claim or cause of action of any nature against THINK Architecture, its officers, directors, employees, agents or sub-consultants which may arise out of or in connection with the use of the electronic files. Furthermore, the Recipient shall, to the fullest extent permitted by law, indemnify, defend, and hold harmless THINK Architecture from all claims, damages, losses and expenses, including attorney fees, arising out of or resulting from the use of these electronic files.

5151 South 900 East
Suite 200
Salt Lake City, Utah 84117
801-269-0055

www.thinkaec.com

THINK Architecture - AGREEMENT FOR USE OF DIGITAL DATA

Electronic files are not contractual documents. Significant differences may exist between electronic files and hard copy contractual documents due to addenda, change orders or other revisions. THINK Architecture makes no representation regarding the accuracy or completeness of the electronic files you receive. In the event that a conflict arises between the signed contract documents prepared by THINK Architecture and electronic files, the recipient is not relieved of their duty to fully comply with the contractual documents, including and without limitation, the need to check, confirm and coordinate all dimensions and details, take field measurements, verify field conditions and coordinate their work with that of other contractors.

Because of the potential that the information presented on the electronic files can be modified, unintentionally or otherwise, THINK Architecture reserves the right to remove all indications of its ownership and/or involvement from each electronic display.

Authorized Signature: _____

Printed Name: _____

Company Name: _____

Date: _____

AIA[®] Document E203™ – 2013

Building Information Modeling and Digital Data Exhibit

This Exhibit dated the day of in the year is incorporated into the agreement (the "Agreement") between the Parties for the following Project:
(Name and location or address of the Project)

Layton City Fire Station 54
Layton, Utah

TABLE OF ARTICLES

- 1 GENERAL PROVISIONS
- 2 TRANSMISSION AND OWNERSHIP OF DIGITAL DATA
- 3 DIGITAL DATA PROTOCOLS
- 4 BUILDING INFORMATION MODELING PROTOCOLS
- 5 OTHER TERMS AND CONDITIONS

ARTICLE 1 GENERAL PROVISIONS

§ 1.1 This Exhibit provides for the establishment of protocols for the development, use, transmission, and exchange of Digital Data for the Project. If Building Information Modeling will be utilized, this Exhibit also provides for the establishment of the protocols necessary to implement the use of Building Information Modeling on the Project, including protocols that establish the expected Level of Development for Model Elements at various milestones of the Project, and the associated Authorized Uses of the Building Information Models.

§ 1.2 The Parties agree to incorporate this Exhibit into their agreements with any other Project Participants that may develop or make use of Digital Data on the Project. Prior to transmitting or allowing access to Digital Data, a Party may require any Project Participant to provide reasonable evidence that it has incorporated this Exhibit into its agreement for the Project, and agreed to the most recent Project specific versions of AIA Document G201™–2013, Project Digital Data Protocol Form and AIA Document G202™–2013, Project Building Information Modeling Protocol Form.

§ 1.2.1 The Parties agree that each of the Project Participants utilizing Digital Data on the Project is an intended third party beneficiary of the Section 1.2 obligation to incorporate this Exhibit into agreements with other Project Participants, and any rights and defenses associated with the enforcement of that obligation. This Exhibit does not create any third-party beneficiary rights other than those expressly identified in this Section 1.2.1.

§ 1.3 Adjustments to the Agreement

§ 1.3.1 If a Party believes that protocols established pursuant to Sections 3.2 or 4.5, and memorialized in AIA Documents G201–2013 and G202–2013, will result in a change in the Party's scope of work or services warranting an adjustment in compensation, contract sum, schedule or contract time, the Party shall notify the other Party. Failure to provide notice as required in this Section 1.3 shall result in a Party's waiver of any claims for

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.

This document is intended to be incorporated into an agreement between the parties and used in conjunction with AIA Documents G201™–2013, Project Digital Data Protocol Form, and G202™–2013, Building Information Modeling Protocol Form. It is anticipated that other Project Participants will incorporate a project specific E203–2013 into their agreements, and that the Parties and other Project Participants will set forth the agreed-upon protocols in AIA Documents G201–2013 and G202–2013.

adjustments in compensation, contract sum, schedule or contract time as a result of the established protocols.

§ 1.3.2 Upon such notice, the Parties shall discuss and negotiate revisions to the protocols or discuss and negotiate any adjustments in compensation, contract sum, schedule or contract time in accordance with the terms of the Agreement.

§ 1.3.3 Notice required under this Section 1.3 shall be provided within thirty days of receipt of the protocols, unless otherwise indicated below:

(If the Parties require a notice period other than thirty days from receipt of the protocols, indicate the notice period below.)

§ 1.4 Definitions

§ 1.4.1 **Building Information Model.** A Building Information Model is a digital representation of the Project, or a portion of the Project, and is referred to in this Exhibit as the "Model," which term may be used herein to describe a Model Element, a single model or multiple models used in the aggregate, as well as other data sets identified in AIA Document G202–2013, Project Building Information Modeling Protocol Form.

§ 1.4.2 **Building Information Modeling.** Building Information Modeling or Modeling means the process used to create the Model.

§ 1.4.3 **Model Element.** A Model Element is a portion of the Model representing a component, system or assembly within a building or building site.

§ 1.4.4 **Level of Development.** The Level of Development (LOD) describes the minimum dimensional, spatial, quantitative, qualitative, and other data included in a Model Element to support the Authorized Uses associated with such LOD.

§ 1.4.5 **Authorized Uses.** The term "Authorized Uses" refers to the permitted uses of Digital Data authorized in the Digital Data and/or Building Information Modeling protocols established pursuant to the terms of this Exhibit.

§ 1.4.6 **Model Element Author.** The Model Element Author is the entity (or individual) responsible for managing and coordinating the development of a specific Model Element to the LOD required for an identified Project milestone, regardless of who is responsible for providing the content in the Model Element. Model Element Authors are to be identified in Section 3.3, Model Element Table, of AIA Document G202–2013.

§ 1.4.7 **Digital Data.** Digital Data is information, including communications, drawings, specifications and designs, created or stored for the Project in digital form. Unless otherwise stated, the term Digital Data includes the Model.

§ 1.4.8 **Confidential Digital Data.** Confidential Digital Data is Digital Data containing confidential or business proprietary information that the transmitting party designates and clearly marks as "confidential."

§ 1.4.9 **Written or In Writing.** In addition to any definition in the Agreement to which this Exhibit is attached, for purposes of this Exhibit and the Agreement, "written" or "in writing" shall mean any communication prepared and sent using a transmission method set forth in this Exhibit, or the protocols developed pursuant to this Exhibit, that permits the recipient to print the communication.

§ 1.4.10 **Written Notice.** In addition to any terms in the Agreement to which this Exhibit is attached, for purposes of this Exhibit and the Agreement, "written notice" shall be deemed to have been duly served if transmitted electronically to an address provided in this Exhibit or the Agreement using a transmission method set forth in this Exhibit that permits the recipient to print the communication.

§ 1.4.11 **Party and Parties.** The terms "Party" and "Parties" refer to the signing parties to the Agreement.

§ 1.4.12 **Project Participant.** A Project Participant is an entity (or individual) providing services, work, equipment or materials on the Project and includes the Parties.

ARTICLE 2 TRANSMISSION AND OWNERSHIP OF DIGITAL DATA

§ 2.1 The transmission of Digital Data constitutes a warranty by the Party transmitting Digital Data to the Party receiving Digital Data that the transmitting Party is the copyright owner of the Digital Data, or otherwise has permission to transmit the Digital Data for its use on the Project in accordance with the Authorized Uses of Digital Data established pursuant to the terms of this Exhibit.

§ 2.2 If a Party transmits Confidential Digital Data, the transmission of such Confidential Digital Data constitutes a warranty to the Party receiving such Confidential Digital Data that the transmitting Party is authorized to transmit the Confidential Digital Data. If a Party receives Confidential Digital Data, the receiving Party shall keep the Confidential Digital Data strictly confidential and shall not disclose it to any other person or entity except as set forth in Section 2.2.1.

§ 2.2.1 The receiving Party may disclose Confidential Digital Data as required by law or court order, including a subpoena or other form of compulsory legal process issued by a court or governmental entity. The receiving Party may also disclose the Confidential Digital Data to its employees, consultants or contractors in order to perform services or work solely and exclusively for the Project, provided those employees, consultants and contractors are subject to the restrictions on the disclosure and use of Confidential Digital Data as set forth in this Exhibit.

§ 2.3 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 designing, constructing, using, maintaining, altering and adding to the Project consistent with the terms of this Exhibit, and nothing contained in this Exhibit conveys any other right to use the Digital Data.

§ 2.4 Where a provision in this Article 2 conflicts with a provision in the Agreement into which this Exhibit is incorporated, the provision in this Article 2 shall prevail.

ARTICLE 3 DIGITAL DATA PROTOCOLS

§ 3.1 **Anticipated Types of Digital Data.** The anticipated types of Digital Data to be used on the Project are as follows: *(Indicate below the information on the Project that shall be created and shared in a digital format. If the Parties indicate that Building Information Modeling will be utilized on the Project, the Parties shall also complete Article 4.)*

Anticipated Digital Data	Applicability to the Project <i>(Indicate Applicable or Not Applicable)</i>	Location of Detailed Description <i>(Section 3.1.1 below or in an attachment to this exhibit and identified below)</i>
Project Agreements and Modifications	Not Applicable	
Project communications	Not Applicable	
Architect’s pre-construction submittals	Not Applicable	
Contract Documents	Applicable	Section 3.1.1.1
Contractor’s submittals	Not Applicable	
Subcontractor’s submittals	Not Applicable	
Modifications	Applicable	Section 3.1.1.1
Project payment documents	Not Applicable	
Notices and claims	Not Applicable	
Building Information Modeling	Not Applicable	

§ 3.1.1 Insert a detailed description of the anticipated Digital Data identified in Section 3.1, if not further described in an attachment to this Exhibit.

§ 3.2 As soon as practical following execution of the Agreement, the Parties shall further describe the uses of Digital Data, and establish necessary protocols governing the transmission and Authorized Uses of Digital Data, in consultation with the other Project Participants that are expected to utilize Digital Data on the Project.

§ 3.2.1 Unless another Project Participant is identified below, the Architect shall prepare and distribute to the other Project Participants Digital Data protocols for review, revision and approval.
(If a Project Participant other than the Architect shall be responsible for preparing draft and final Digital Data protocols, identify that Project Participant.)

None

§ 3.2.2 The agreed upon Digital Data protocols shall be set forth in AIA Document G201–2013 and each Project Participant shall memorialize their agreement in writing to such Digital Data protocols.

§ 3.2.3 The Parties, together with the other Project Participants, shall review and, if necessary, revise the Digital Data protocols at appropriate intervals as required by the conditions of the Project.

§ 3.3 The Parties shall transmit, use, store and archive Digital Data in accordance with the Digital Data protocols set forth in the latest version of AIA Document G201–2013 agreed to by the Project Participants.

§ 3.4 Unauthorized Use

§ 3.4.1 Prior to Establishment of Digital Data Protocols

If a Party receives Digital Data prior to the agreement to, and documentation of, the Digital Data protocols in AIA Document G201–2013, that Party is not authorized to use or rely on the Digital Data. Any use of, or reliance on, such Digital Data is at that Party’s sole risk and without liability to the other Party and its contractors, consultants, agents and employees.

§ 3.4.2 Following Establishment of Digital Data Protocols

Following agreement to, and documentation of, the Digital Data protocols in AIA Document G201–2013, if a Party uses Digital Data inconsistent with the Authorized Uses identified in the Digital Data protocols, that use shall be at the sole risk of the Party using the Digital Data.

§ 3.5 Digital Data Management

§ 3.5.1 Centralized electronic document management system use on the Project shall be:

(Check the appropriate box. If the Parties do not check one of the boxes below, the default selection shall be that the Parties will not utilize a centralized electronic document management system on the Project.)

The Parties intend to use a centralized electronic document management system on the Project.

The Parties do not intend to use a centralized electronic document management system on the Project.

§ 3.5.2 If the Project Participants intend to utilize a centralized electronic document management system on the Project, the Project Participants identified in Section 3.5.3 shall be responsible for managing and maintaining such system. The Project Participants responsible for managing and maintaining the centralized electronic document management system shall facilitate the establishment of protocols for transmission, use, storage and archiving of the centralized Digital Data and assist the Project Participants identified in Section 3.2.1 above in preparing Digital Data protocols. Upon agreement to, and documentation of, the Digital Data protocols in AIA Document G201–2013, the Project Participants identified in Section 3.5.3 shall manage and maintain the centralized electronic document management system consistent with the management protocols set forth in the latest version of G201–2013 approved by the Project Participants.

§ 3.5.3 Unless responsibility is assigned to another Project Participant, the Architect shall be responsible for managing and maintaining the centralized electronic document management system. If the responsibility for management and maintenance will be assigned to another Project Participant at an identified Project milestone, indicate below the Project Participant who shall assume that responsibility, and the Project milestone.

(Identify the Project Participant responsible for management and maintenance only if the Parties intend to utilize a centralized electronic document management system on the Project.)

Responsible Project Participant

Project Milestone

Init.

ARTICLE 4 BUILDING INFORMATION MODELING PROTOCOLS

§ 4.1 If the Parties indicate in Section 3.1 that Building Information Modeling will be used on the Project, specify below the extent to which the Parties intend to utilize Building Information Modeling and identify the provisions of this Article 4 governing such use:

[X] The Parties shall utilize Building Information Modeling on the Project for the sole purpose of fulfilling the obligations set forth in the Agreement without an expectation that the Model will be relied upon by the other Project Participants. Unless otherwise agreed in writing, any use of, transmission of, or reliance on the Model is at the receiving Party’s sole risk. The remaining sections of this Article 4 shall have no force or effect.

[] The Parties shall develop, share, use and rely upon the Model in accordance with Sections 4.2 through 4.10 of this Exhibit.

§ 4.2 **Anticipated Building Information Modeling Scope.** Indicate below the portions of the Project for which Modeling will be used and the anticipated Project Participant responsible for that Modeling.

Project Portion for Modeling	Responsible Project Participant
------------------------------	---------------------------------

§ 4.3 **Anticipated Model Authorized Uses.** Indicate below the anticipated Authorized Uses of the Model for the Project, which Authorized Uses will be agreed upon by the Project Participants and further described for each LOD in AIA Document G202–2013.

None

§ 4.4 **Ancillary Modeling Activities.** Indicate additional Modeling activities agreed upon by the Parties, but not to be included in AIA Document G202–2013, if any.
(Describe any Modeling activities, such as renderings, animations, performance simulations, or other similar use, including the anticipated amount and scope of any such Modeling activities.)

None

§ 4.5 **Modeling Protocols.** As soon as practical following execution of the Agreement, the Parties shall, in consultation with the other Project Participants that are expected to utilize Building Information Modeling on the Project, further describe the Authorized Uses of the Model and establish necessary protocols governing the development of the Model utilizing AIA Document G202–2013.

§ 4.5.1 The Modeling protocols shall address the following:

- .1 Identification of the Model Element Authors;
- .2 Definition of the various LOD for the Model Elements and the associated Authorized Uses for each defined LOD;
- .3 Identification of the required LOD of each Model Element at each identified Project milestone;
- .4 Identification of the construction classification systems to be used on the Project;
- .5 The process by which Project Participants will exchange and share the Model at intervals not reflected in Section 3.3, Model Element Table, of AIA Document G202–2013;
- .6 The process by which the Project Participants will identify, coordinate and resolve changes to the Model;
- .7 Details regarding any anticipated as-designed or as-constructed Authorized Uses for the Model, if required on the Project;
- .8 Anticipated Authorized Uses for facilities management or otherwise, following completion of the Project; and
- .9 Other topics to be addressed by the Modeling protocols: *(Identify additional topics to be addressed by the Modeling Protocols.)*

§ 4.5.2 Unless responsibility is assigned to another Project Participant identified below, the Architect shall prepare and distribute Modeling protocols to the other Project Participants for review, revision and approval. *(If a Project Participant other than the Architect shall be responsible for preparing draft and final Modeling protocols, identify that Project Participant.)*

§ 4.5.3 The agreed upon Modeling protocols shall be set forth in AIA Document G202–2013 and each Project Participant shall memorialize their agreement in writing to such Modeling protocols.

§ 4.5.4 The Parties, together with the other Project Participants, shall review, and if necessary, revise the Modeling protocols at appropriate intervals as required by the conditions of the Project.

§ 4.6 The Parties shall develop, use and rely on the Model in accordance with the Modeling protocols set forth in the latest version of AIA Document G202–2013, which document shall be included in or attached to the Model in a manner clearly accessible to the Project Participants.

§ 4.7 Unauthorized Use

§ 4.7.1 Prior to Establishment of Modeling Protocols

If a Party receives any Model prior to the agreement to, and documentation of, the Modeling protocols in AIA Document G202–2013, that Party is not authorized to use, transmit, or rely on the Model. Any use, transmission or reliance is at that Party’s sole risk and without liability to the other Party and its contractors, consultants, agents and employees.

§ 4.7.2 Following Establishment of Modeling Protocols

Following agreement to, and documentation of, the Modeling protocols in AIA Document G202–2013, if a Party uses or relies on the Model inconsistent with the Authorized Uses identified in the Modeling protocols, such use or reliance shall be at the sole risk of the Party using or relying on the Model. A Party may rely on the Model Element only to the extent consistent with the minimum data required for the identified LOD, even if the content of a specific Model Element includes data that exceeds the minimum data required for the identified LOD.

§ 4.8 Model Management

§ 4.8.1 The requirements for managing the Model include the duties set forth in this Section 4.8. Unless assigned to another Project Participant, the Architect shall manage the Model from the inception of the Project. If the responsibility for Model management will be assigned to another Project Participant, or change at an identified Project milestone, indicate below the identity of the Project Participant who will assume that responsibility, and the Project milestone.

Responsible Project Participant	Project Milestone
---------------------------------	-------------------

§ 4.8.2 **Model Management Protocol Establishment.** The Project Participant responsible for managing the Model, in consultation with the other Project Participants that are expected to utilize Building Information Modeling on the Project, shall facilitate the establishment and revision of Model management protocols, including the following:

- .1 Model origin point, coordinate system, precision, file formats and units
- .2 Model file storage location(s)
- .3 Processes for transferring and accessing Model files
- .4 Naming conventions
- .5 Processes for aggregating Model files from varying software platforms
- .6 Model access rights
- .7 Identification of design coordination and clash detection procedures.
- .8 Model security requirements
- .9 Other: *(Identify additional Model management protocols to be addressed.)*

§ 4.8.3 Ongoing Responsibilities. The Project Participant responsible for managing the Model shall do so consistent with the Model management protocols, which shall also include the following ongoing responsibilities:

- .1 Collect incoming Models:
 - .1 Coordinate submission and exchange of Models
 - .2 Create and maintain a log of Models received
 - .3 Review Model files for consistency with Sections 4.8.2.1 through 4.8.2.5
 - .4 Maintain a record copy of each Model file received
- .2 Aggregate Model files and make them available for Authorized Uses
- .3 Maintain Model Archives and backups consistent with the requirements of Section 4.8.4 below
- .4 Manage Model access rights
- .5 Other: *(Identify additional responsibilities.)*

§ 4.8.4 Model Archives. The individual or entity responsible for Model management as set forth in this Section 4.8 shall compile a Model Archive at the end of each Project milestone and shall preserve it without alteration as a record of Model completion as of that Project milestone.

§ 4.8.4.1 Additional Model Archive requirements, if any, are as follows:

None

§ 4.8.4.2 The procedures for storing and preserving the Model(s) upon final completion of the Project are as follows:

None

§ 4.9 Post-Construction Model. The services associated with providing a Model for post-construction use shall only be required if specifically designated in the table below as a Party's responsibility. *(Designate below any anticipated post-construction Model and related requirements, the Project Participant responsible for creating or adapting the Model to achieve such uses, and the location of a detailed description of the anticipated scope of services to create or adapt the Model as necessary to achieve such uses.)*

Post-Construction Model	Applicability to Project <i>(Applicable or Not Applicable)</i>	Responsible Project Participant	Location of Detailed Description of Requirements and Services <i>(Section 4.10 below or in an attachment to this exhibit and identified below)</i>
§ 4.9.1 Remodeling	Not Applicable		
§ 4.9.2 Wayfinding and Mapping	Not Applicable		
§ 4.9.3 Asset/FF & E Management	Not Applicable		
§ 4.9.4 Energy Management	Not Applicable		
§ 4.9.5 Space Management	Not Applicable		
§ 4.9.6 Maintenance Management	Not Applicable		

§ 4.10 Insert a detailed description of the requirements for each Post-Construction Model identified in Section 4.9 and the anticipated services necessary to create each Post-Construction Model, if not further described in an attachment to this Exhibit.

Not Applicable

ARTICLE 5 OTHER TERMS AND CONDITIONS

Other terms and conditions related to the transmission and use of Digital Data are as follows:

None

Additions and Deletions Report for AIA® Document E203™ – 2013

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 14:05:12 MT on 11/18/2020.

PAGE 1

Layton City Fire Station 54
Layton, Utah

PAGE 3

Project Agreements and Modifications	<u>Not Applicable</u>	
Project communications	<u>Not Applicable</u>	
Architect’s pre-construction submittals	<u>Not Applicable</u>	
Contract Documents	<u>Applicable</u>	<u>Section 3.1.1.1</u>
Contractor’s submittals	<u>Not Applicable</u>	
Subcontractor’s submittals	<u>Not Applicable</u>	
Modifications	<u>Applicable</u>	<u>Section 3.1.1.1</u>
Project payment documents	<u>Not Applicable</u>	
Notices and claims	<u>Not Applicable</u>	
Building Information Modeling	<u>Not Applicable</u>	

PAGE 4

None

...

[X] The Parties do not intend to use a centralized electronic document management system on the Project.

PAGE 5

[X] The Parties shall utilize Building Information Modeling on the Project for the sole purpose of fulfilling the obligations set forth in the Agreement without an expectation that the Model will be relied upon by the other Project Participants. Unless otherwise agreed in writing, any use of, transmission of, or reliance on the Model is at the receiving Party’s sole risk. The remaining sections of this Article 4 shall have no force or effect.

...

None

...

None

PAGE 7

None

...

None

...

§ 4.9.1	Remodeling	<u>Not Applicable</u>		
§ 4.9.2	Wayfinding and Mapping	<u>Not Applicable</u>		
§ 4.9.3	Asset/FF & E Management	<u>Not Applicable</u>		
§ 4.9.4	Energy Management	<u>Not Applicable</u>		
§ 4.9.5	Space Management	<u>Not Applicable</u>		
§ 4.9.6	Maintenance Management	<u>Not Applicable</u>		

...

Not Applicable

...

None

Certification of Document's Authenticity

AIA® Document D401™ – 2003

I, Corey R. Solum, AIA, 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 14:05:12 MT on 11/18/2020 under Order No. 8184578310 from AIA Contract Documents software and that in preparing the attached final document I made no changes to the original text of AIA® Document E203™ – 2013, Building Information Modeling and Digital Data Exhibit, as published by the AIA in its software, other than those additions and deletions shown in the associated Additions and Deletions Report.

(Signed)

(Title)

(Dated)

DOCUMENT 004133 – BID SECURITY FORMS

1.1 INSTRUCTIONS TO BIDDERS

A. AIA Document A312, "Performance Bond," is hereby incorporated into the Procurement and Contracting Requirements by reference.

1. A copy of AIA Document A312, "Performance Bond," is bound in this Project Manual.

B. AIA Document A310, "Bid Bond," is hereby incorporated into the Procurement and Contracting Requirements by reference.

1. A copy of AIA Document A310, "Bid Bond," is bound in this Project Manual.

END OF DOCUMENT 004133

SECTION 01 1000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Project Information.
2. Work covered by the Contract Documents.
3. Work phases.
4. Work under other contracts.
5. Use of premises.
6. Owner's occupancy requirements.
7. Work restrictions.
8. Specification formats and conventions.

B. Related Requirements:

1. Division 01 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.2 PROJECT INFORMATION

A. Project Identification: Layton Fire Station #54

1. Project Location: 1100 North Valley View Drive
Layton, UT 84040

B. Owner:

1. Owner: Murray City Corporation
2. Owner's Representative: Gil Rodriguez, Fire Chief
Jon Harris, Battalion Commander

C. Architect: Think Architecture, Inc.

7927 High Point Parkway, Suite 300
Sandy, Utah 84094
Office: (801) 269-0055
Fax: (801) 269-1425
Website: www.thinkaec.com

D. Architect's Consultants: The Architect has retained the following design professionals who have prepared designated portions of the Contract Documents:

1. Structural Engineer: Calder Richards Structural Engineers.
2. Landscape Architect: Think Architecture, Inc.

3. Mechanical / Electrical / Plumbing Engineer: Spectrum Engineers, Inc.
4. Civil Engineer: Excel Engineering, Inc.

E. Owner Consultants: The Owner has retained the following design professional who have prepared designated portions of the Contract Documents:

1. Geotechnical Engineering: GSH Geotechnical Inc.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work includes but is not limited to the following:

1. Layton Fire Station #54 for the Layton City Fire Department consisting of a 3 bay one story commercial grade building of approximately 10,061 square feet. The program includes 7 sleeping rooms for fire fighters. The building is to be of wood framed structure with CMU veneer and Fiber Cement Siding.

B. Project will be constructed under a single prime contract.

1.4 WORK PHASES

A. The Work is to be conducted in a single phase.

1.5 WORK UNDER OTHER CONTRACTS: None.

1.6 USE OF PREMISES

A. General: Contractor shall have limited use of premises for construction operations as indicated on Drawings by the Contract limits.

B. Use of Site: Limit use of premises to work areas indicated and access thereto. Do not disturb portions of project site beyond areas in which the Work is indicated. Owner will designate construction staging, delivery and trash areas and Contractor parking area.

1. Owner Occupancy: None.
2. Driveways and Entrances: Keep driveways 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 storage of materials.
 - a. Schedule deliveries to minimize obstruction of driveways and entrances.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

1.7 OWNER'S OCCUPANCY REQUIREMENTS

A. Full Owner Occupancy: None.

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 authorities having jurisdiction.

B. Owner Occupancy of Completed Areas of Construction: None.

1.8 WORK RESTRICTIONS

A. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor air intakes.

B. On-Site Work Hours: Limit work on the project to normal business working hours as per Layton City Ordinance or unless otherwise indicated.

1. Weekend Hours: As permitted by authorities having jurisdiction or restriction for weekend or early hour work.
2. Early Morning Hours: As permitted by authorities having jurisdiction or restriction for weekend or early hour work.

C. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.

1. Notify Owner not less than two days in advance of proposed disruptive operations.
2. Obtain Owner's written permission before proceeding with disruptive operations.

D. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor-air intakes.

E. Controlled Substances: Use of controlled substances on Project site is not permitted.

1.9 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Format: The Specifications are organized into Divisions and Sections using the 33-division format and CSI/CSC's "Master-Format" numbering system.

B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

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 published as part of the U.S. National CAD Standard and scheduled on Drawings.
 3. Keynoting: 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 01 1000

SECTION 01 2500 - 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.
- B. Related Requirements:
 - 1. Division 01 Section "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.
 - 2. Divisions 02 through 33 Sections for specific requirements and limitations for substitutions.

1.3 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 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 in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify 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 CSI Form 13.1A.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
 - b. Coordination 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 substitution 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 and 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 2009 IBC.
 - j. Cost information, including a proposal of change, if any, in the Contract Sum.
 - k. 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.
 - l. 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.

PART 2 - PRODUCTS

2.1 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: Architect will consider requests for substitution if received within 60 days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Architect.
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 offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - b. Requested substitution does not require extensive revisions to the Contract Documents.
 - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - d. Substitution request is fully documented and properly submitted.
 - e. Requested substitution will not adversely affect Contractor's construction schedule.
 - f. Requested substitution has received necessary approvals of authorities having jurisdiction.

- g. Requested substitution is compatible with other portions of the Work.
- h. Requested substitution has been coordinated with other portions of the Work.
- i. Requested substitution provides specified warranty.
- j. 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.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2500

SECTION 01 2600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.

1.2 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 either the form "Request for Information" or "Architect's Supplemental Instructions."

1.3 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. Proposal Requests issued by Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
 - 2. Within 21 (twenty-one) calendar days 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. Use mark-ups as agreed to by Owner unless noted otherwise in the General Conditions of the Contract for Construction.
 - e. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
- B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes 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. Use mark-up as agreed to by Owner unless noted otherwise in the General Conditions of the Contract for Construction.
 6. 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.
 7. Comply with requirements in Division 01 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.
- C. Proposal Request Form: Use forms provided by Owner.
- 1.4 CHANGE ORDER PROCEDURES
- A. On Owner's approval of a Proposal Request, Architect will issue a Change Order for signatures of Owner, A/E, and Contractor on form directed by Owner.
- 1.5 CONSTRUCTION CHANGE DIRECTIVE
- A. Construction Change Directive: Architect may issue a Construction Change Directive on form directed by Owner. 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 01 2600

SECTION 01 2900 - 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. Division 01 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 2. Division 01 Section "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

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 other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with continuation sheets.
 - b. Submittal schedule.
 - c. 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.

- 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. Name of Architect.
 - c. Architect's project number.
 - d. Contractor's name and address.
 - e. 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. Change Orders (numbers) that affect value.
 - d. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
 - 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. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
 - a. 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.
 5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
 6. 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. If required, include evidence of insurance.
 7. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
 8. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.

9. Purchase Contracts: Provide a separate line item in the schedule of values for each purchase contract. Show line-item value of purchase contract. Indicate owner payments or deposits, if any, and balance to be paid by Contractor.
10. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
11. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

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.
 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- 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.
- F. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt. One copy shall include waivers of lien and similar attachments if required.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens 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. Schedule of unit prices.
 5. Copies of building permits.
 6. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 7. Report of preconstruction conference.
 8. Certificates of insurance and insurance policies for General Contractor.
 9. Performance and payment bonds or surety per construction contract agreement.
 10. Data needed to acquire Owner's insurance.

- I. 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.
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

- J. 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. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 2. Updated final statement, accounting for final changes to the Contract Sum.
 3. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
 4. AIA Document G707, "Consent of Surety to Final Payment."
 5. Evidence that claims have been settled.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2900

SECTION 01 3100 - 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. Requests for Information (RFIs).
 - 4. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Related Requirements:
 - 1. Division 01 Section "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
 - 2. Division 01 Section "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 3. Division 01 Section "Closeout Procedures" for coordinating closeout of the Contract.
 - 4. Division 01 Section "General Commissioning Requirements" for coordinating the Work with Owner's Commissioning Authority.

1.3 DEFINITIONS

- A. RFI: Request from Owner, Architect, or 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, and telephone number of entity performing subcontract or supplying products.
 2. Number and title of related Specification Section(s) covered by subcontract.
 3. Drawing number and detail references, as appropriate, covered by subcontract.
- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and 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, and by each temporary telephone. 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 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.

- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
 - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

1.6 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
 - 1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in 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, civil, mechanical, and electrical systems.
 - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - f. Indicate required installation sequences.
 - g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
 - 1. Plenum Space: Indicate sub-framing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
 - 2. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
 - 3. Structural Penetrations: Indicate penetrations and openings required for all disciplines.

4. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
 5. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.
 6. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Division 01 Section "Submittal Procedures."
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
 2. File Preparation Format: DWG, Version 2004 or newer, operating in Microsoft Windows operating system.
 3. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format.
 4. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
 - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
 - b. Digital Data Software Program: Drawings are available in AutoCAD 2010; Windows Operating System.
 - c. Contractor shall execute a data licensing agreement in the form of AIA Document C106 or another Agreement form acceptable to Owner and Architect.
- 1.7 REQUESTS FOR INFORMATION (RFIs)
- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
 2. Coordinate and submit RFIs in a prompt manner so as 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. Project number.
 3. Date.
 4. Name of Contractor.

5. Name of Architect.
 6. RFI number, numbered sequentially.
 7. RFI subject.
 8. Specification Section number and title and related paragraphs, as appropriate.
 9. Drawing number and detail references, as appropriate.
 10. Field dimensions and conditions, as appropriate.
 11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 12. Contractor's signature.
 13. 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 Adobe Acrobat PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working 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 of additional information.
 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 Division 01 Section "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 10 days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include 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.
- 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 within seven days if Contractor disagrees with response.
1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 2. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.8 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.
 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 Five days of the meeting.
- B. Preconstruction Conference: 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. Conduct the conference to review responsibilities and personnel assignments.
 2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Phasing.
 - c. Critical work sequencing and long-lead items.
 - d. Designation of key personnel and their duties.
 - e. Lines of communications.
 - f. Procedures for processing field decisions and Change Orders.
 - g. Procedures for RFIs.
 - h. Procedures for testing and inspecting.
 - i. Procedures for processing Applications for Payment.
 - j. Distribution of the Contract Documents.

- k. Submittal procedures.
 - l. Preparation of record documents.
 - m. Use of the premises.
 - n. Work restrictions.
 - o. Working hours.
 - p. Owner's occupancy requirements.
 - q. Responsibility for temporary facilities and controls.
 - r. Procedures for moisture and mold control.
 - s. Office, work, and storage areas.
 - t. First aid.
 - u. Security.
 - v. Progress cleaning.
4. 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 that requires 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 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. Submittals.
 - f. Review of mockups.
 - g. Possible conflicts.
 - h. Compatibility requirements.
 - i. Time schedules.
 - j. Weather limitations.
 - k. Manufacturer's written instructions.
 - l. Warranty requirements.
 - m. Compatibility of materials.
 - n. Temporary facilities and controls.
 - o. Regulations of authorities having jurisdiction.
 - p. Coordination with other work.
 - q. Required performance results.
 - r. Protection of adjacent work.
 - 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 60 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, 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. Submittal of written warranties.
 - d. Requirements for preparing operations and maintenance data.
 - e. Requirements for delivery of material samples, attic stock, and spare parts.
 - f. Requirements for demonstration and training.
 - g. Preparation of Contractor's punch list.
 - h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - i. Installation of Owner's furniture, fixtures, and equipment.
 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- E. Progress Meetings: Conduct progress meetings at regular intervals as required by Project Construction Progress.
1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.

- b. Review present and future needs of each entity present, including the following:
 - 1) Sequence of operations.
 - 2) Status of submittals.
 - 3) Quality and work standards.
 - 4) Field observations.
 - 5) Status of RFIs.
 - 6) Status of proposal requests.
 - 7) Pending changes.
- 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 3100

SECTION 01 3200 - 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. Construction reports.
 - 5. Material location reports.
 - 6. Site condition reports.
 - 7. Special reports.
- B. Related Requirements:
 - 1. Division 01 Section "Submittal Procedures" for submitting schedules and reports.
 - 2. Division 01 Section "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

- D. Event: The starting or ending point of an activity.
- E. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- F. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. Working electronic copy of schedule file, where indicated.
 - 2. PDF electronic file.
- B. Startup construction schedule.
 - 1. Approval of cost-loaded, startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.
- C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
 - 1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.
- E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
 - 1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
 - 2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
 - 3. Total Float Report: List of all activities sorted in ascending order of total float.
- F. Construction Schedule Updating Reports: Submit with Applications for Payment.
- G. Construction Reports: Submit at monthly intervals.

- H. Material Location Reports: Submit at monthly intervals.
- I. Site Condition Reports: Submit at time of discovery of differing conditions.
- J. Special Reports: Submit at time of unusual event.
- K. Qualification Data: For scheduling consultant.

1.5 QUALITY ASSURANCE

- A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.
- B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:
 - 1. Review software limitations and content and format for reports.
 - 2. Verify availability of qualified personnel needed to develop and update schedule.
 - 3. Discuss constraints, including phasing, interim milestones and partial Owner occupancy.
 - 4. Review delivery dates for Owner-furnished products.
 - 5. Review schedule for work of Owner's separate contracts.
 - 6. Review submittal requirements and procedures.
 - 7. Review time required for review of submittals and resubmittals.
 - 8. Review requirements for tests and inspections by independent testing and inspecting agencies.
 - 9. Review time required for Project closeout and Owner startup procedures, including commissioning activities.
 - 10. Review and finalize list of construction activities to be included in schedule.
 - 11. Review procedures for updating schedule.

1.6 COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.
- B. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from entities involved.
 - 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for commencement of the Work to date of 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.
- B. Activities: Treat each story 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 20 days, unless specifically allowed by Architect.
 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 3. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
 4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
 5. 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.
 6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
- C. 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. Phasing: Arrange list of activities on schedule by phase.
 2. Work under More Than One Contract: Include a separate activity for each contract.
 3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 6. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use of premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.

7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Submittals.
 - b. Mockups.
 - c. Tests and inspections.
 - d. Adjusting.
 - e. Building flush-out.
 - f. Startup and placement into final use and operation.
 8. 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.
- D. 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.
 2. Individual Building Completion and Occupancy milestones.
- E. 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 Contract Time.
- F. Recovery Schedule: When periodic update indicates the Work is 21 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.
- G. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
1. Use Microsoft Project, Primavera, Meridian Prolog, or an Owner approved Software for Windows XP, Windows Vista, or compatible Windows Software operating system.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

- 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 to Proceed. 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 20 percent increments within time bar.

2.3 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. Accidents.
 - 8. Meetings and significant decisions.
 - 9. Unusual events (see special reports).
 - 10. Stoppages, delays, shortages, and losses.
 - 11. Meter readings and similar recordings.
 - 12. Emergency procedures.
 - 13. Orders and requests of authorities having jurisdiction.
 - 14. Change Orders received and implemented.
 - 15. Construction Change Directives received and implemented.
 - 16. Services connected and disconnected.
 - 17. Equipment or system tests and startups.
 - 18. Partial completions and occupancies.
 - 19. Substantial Completions authorized.
- B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:
 - 1. Material stored prior to previous report and remaining in storage.
 - 2. Material stored prior to previous report and since removed from storage and installed.
 - 3. Material stored following previous report and remaining in storage.

- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.4 SPECIAL REPORTS

- A. General: Submit special reports directly to Owner within 3 day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.
- B. Reporting Unusual Events: 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, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before 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.
- B. 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.

END OF SECTION 01 3200

SECTION 01 3300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. See Division 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule.
- C. See Division 01 Section "Closeout Procedures" for submitting warranties.
- D. See Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.

1.2 RESPONSIBILITY

- A. Contractor (Each Subcontractor) shall be solely responsible and assumes full liability for ensuring that submittals are timely provided to the Architect, and the content thereof complies in full, and is provided in accordance, with the Drawings and Specifications for the Project. The Contractor (Subcontractor) hereby agrees to hold harmless the Architect, its officers, employees, agents and consultants from failure to comply with this provision. Contractor further agrees to defend and indemnify Architect, its officers, employees, agents and consultants for any and all injuries, damages and liability resulting from a breach hereof.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information that requires Architect's responsive action.
- B. Informational Submittals: Written information that does not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

1.4 SUBMITTAL PROCEDURES

- A. 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. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- B. Submittals Schedule: Comply with requirements in Division 01 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.
- C. Processing Time: Allow enough 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 (fifteen) 15 calendar 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 (ten) 10 calendar days for review of each resubmittal.
- D. Identification: Place a permanent label or title block on each submittal for identification.
 1. Indicate name of firm or entity that prepared each submittal on label or title block.
 2. Provide a space approximately 4 inches by 6 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
 3. Include the following information on label for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name and address of subcontractor.
 - d. Name and address of supplier.
 - e. Name of manufacturer.
 - f. Submittal number or other unique identifier, including revision identifier.
 - g. Number and title of appropriate Specification Section.
 - h. Drawing number and detail references, as appropriate.
 - i. Location(s) where product is to be installed, as appropriate.
 - j. Other necessary identification.
- E. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.

- F. 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.
 - 1. Additional copies submitted for maintenance manuals will not be marked with action taken and will be returned.
- G. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return submittals, without review received from sources other than Contractor.
 - 1. Transmittal Form: Use AIA Document G810.
- H. 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.
- I. Email Submittals: Are approved for use; unless, a color chart or product sample is required as part of the submittal.
 - 1. Provide e-submittals as non-protected pdf's, so they can be marked on electronically, with the same information as the paper copy.
 - 2. If submitted as email this is the information that will be reviewed, marked-up if needed, and returned to the contractor.
 - 3. Contractor is responsible for distribution as noted in paragraph 'J' below and elsewhere in this document.
- J. 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.
- K. Use for Construction: Use only final submittals with mark indicating approval notation from Architect's action stamp taken by Architect.

1.5 CONTRACTOR'S USE OF ARCHITECT'S CAD FILES

General: At Contractor's written request, copies of Architect's CAD files or BIM Model will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions: Think Architecture, Planning and Interior Design, has provided electronic files for the convenience and use in the preparation of drawings related to the above referenced project, subject to the following terms and conditions:

- 1. Electronic files are compatible with Think software and hardware. Think makes no representation as to the compatibility of these files with other software or hardware.

2. Data contained on these electronic files is part of Think's instrument of service, and are copy-righted by Think. The electronic data shall not be used by anyone for any purpose other than as a convenience in the preparation of drawings for the referenced project. The information provided shall not be released to any other party without the written consent of Think. Any use or reuse, by you or by others, will be at your sole risk and without liability or legal exposure to Think. Think hereby grants a limited use agreement of their copyright for the sole purpose of a convenience in the preparation of drawings for the referenced project. All other uses of the Think electronic data are excluded from this limited use agreement and will be prosecuted to the fullest extent of the law.
3. Think makes no responsibility for viruses or other harmful hidden electronic files or data possibly included in the Think electronic files. It is the responsibility of the Recipient to scan for and remove all viruses or potentially harmful data prior to use. Think takes no responsibility for possible software errors that may affect the information or performance of the information included in these files.
4. The Recipient agrees to make no claim and hereby waives, to the fullest extent permitted by law, any claim or cause of action of any nature against Think, its officers, directors, employees, agents or sub-consultants which may arise out of or in connection with the use of the electronic files. Furthermore, the Recipient shall, to the fullest extent permitted by law, indemnify, defend, and hold harmless Think from all claims, damages, losses and expenses, including attorney fees, arising out of or resulting from the use of these electronic files.
5. Electronic files are not contractual documents. Significant differences may exist between electronic files and hard copy contractual documents due to addenda, change orders or other revisions. Think makes no representation regarding the accuracy or completeness of the electronic files you receive. In the event that a conflict arises between the signed contract documents prepared by Think and electronic files, the recipient is not relieved of their duty to fully comply with the contractual documents, including and without limitation, the need to check, confirm and coordinate all dimensions and details, take field measurements, verify field conditions and coordinate their work with that of other contractors.
6. Because of the potential that the information presented on the electronic files can be modified, unintentionally or otherwise, Think reserves the right to remove all indications of its ownership and/or involvement from each electronic display.

1.6 ACTION SUBMITTALS

- A. General: Prepare and submit Action Submittals required by individual Specification Sections.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 1. Number of Copies: Submit (one) 1 copy of Product Data in digital PDF format, unless otherwise indicated. Architect will return copies depending on submittal. Mark up and retain one returned copy as a Project Record Document.

- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal of Architect's CAD Drawings is otherwise permitted.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
 - 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 - 2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of appropriate Specification Section.
 - 3. 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.
 - 4. 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 (one) 1 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 submittal with options selected.
- E. Submittals Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."

1.7 INFORMATIONAL SUBMITTALS

- A. General: Prepare and submit Informational Submittals required by other Specification Sections.
 - 1. Number of Copies: Submit (one) 1 copy of Product Data in digital PDF format, unless otherwise indicated. Architect will not return copies.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
- C. Contractor is responsible for final review prior to installing the Work.

3.2 ARCHITECT'S ACTION

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken.
- C. 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.
- D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
- E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 01 3300

SECTION 01 4000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 2. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- C. See Divisions 02 through 33 Sections for specific test and inspection requirements.

1.2 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- D. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- E. 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, and similar operations.
 - 1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.

1.3 CONFLICTING REQUIREMENTS

- A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.4 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- C. 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.
- D. 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.
- 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 are similar to those indicated for this Project in material, design, and extent.
- F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
 - 1. Requirement for specialists shall not supersede building codes and regulations governing the Work.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
 1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
 2. Comply with the Contract Document requirements for Division 01 Section "Cutting and Patching."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 4000

SECTION 01 4200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 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.
- 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.

1.4 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 Thomson Gale's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."
- B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

AA	Aluminum Association (The) www.aluminum.org	(703) 358-2960
AABC	Associated Air Balance Council www.aabchq.com	(202) 737-0202
AAMA	www.aamanet.org	
AASHTO	American Association of State Highway and Transportation Officials	(202) 624-5800
AATCC	American Association of Textile Chemists and Colorists www.aatcc.org	(919) 549-8141
ABAA	Air Barrier Association of America www.airbarrier.org	(866) 956-5888
ABMA	www.abma-dc.org	
ACI	American Concrete Institute	(248) 848-3700
ACPA	American Concrete Pipe Association	(972) 506-7216

	www.concrete-pipe.org	
AEIC	Association of Edison Illuminating Companies, Inc. (The) www.aeic.org	(205) 257-2530
AF&PA	www.afandpa.org	(202) 463-2700
AGA	American Gas Association	(202) 824-7000
AHAM	Association of Home Appliance Manufacturers www.aham.org	(202) 872-5955
AHRI	Air-Conditioning, Heating and Refrigeration Institute, The www.ahrinet.org	(703) 524-8800
AI	www.asphaltinstitute.org	
AIA	American Institute of Architects (The)	(800) 242-3837
AISC	American Institute of Steel Construction www.aisc.org	(800) 644-2400 (312) 670-2400
AISI	American Iron and Steel Institute www.steel.org	(202) 452-7100
AITC	www.aitc-glulam.org	
ALSC	American Lumber Standard Committee, Incorporated	(301) 972-1700
AMCA	Air Movement and Control Association International, Inc. www.amca.org	(847) 394-0150
ANSI	American National Standards Institute www.ansi.org	(202) 293-8020
AOSA	www.aosaseed.com	
APA	APA - The Engineered Wood Association	(253) 565-6600
APA	Architectural Precast Association www.archprecast.org	(239) 454-6989
API	American Petroleum Institute www.api.org	(202) 682-8000

ARI	www.ari.org	
ARMA	Asphalt Roofing Manufacturers Association	(202) 207-0917
ASCE	American Society of Civil Engineers www.asce.org	(800) 548-2723 (703) 295-6300
ASCE/SEI	American Society of Civil Engineers/Structural Engineering Institute (See ASCE)	
ASHRAE	www.ashrae.org	(404) 636-8400
ASME	ASME International www.asme.org	(800) 843-2763
ASSE	American Society of Sanitary Engineering	(440) 835-3040
ASTM	ASTM International (American Society for Testing and Materials International)	(610) 832-9500
ATIS	Alliance for Telecommunications Industry Solutions www.atis.org	(202) 628-6380
AWCMA	American Window Covering Manufacturers Association (Now WCMA)	
AWCI	www.awci.org	
AWI	Architectural Woodwork Institute	(571) 323-3636
AWPA	American Wood Protection Association (Formerly: American Wood Preservers' Association)	(205) 733-4077
AWS	American Welding Society www.aws.org	(800) 443-9353 (305) 443-9353
AWWA	American Water Works Association www.awwa.org	(800) 926-7337 (303) 794-7711
BHMA		

	www.buildershardware.com	
BIA	Brick Industry Association (The)	(703) 620-0010
BICSI	BICSI, Inc. www.bicsi.org	(800) 242-7405 (813) 979-1991
BIFMA	BIFMA International (Business and Institutional Furniture Manufacturer's Association International) www.bifma.com	(616) 285-3963
BISSC	Baking Industry Sanitation Standards Committee www.bissc.org	(866) 342-4772
CCC	www.carpetcushion.org	
CDA	Copper Development Association	(800) 232-3282
CEA	Canadian Electricity Association www.canelect.ca	(613) 230-9263
CEA	Consumer Electronics Association www.ce.org	(866) 858-1555 (703) 907-7600
CFFA	www.chemicalfabricsandfilm.com	
CGA	Compressed Gas Association	(703) 788-2700
CIMA	Cellulose Insulation Manufacturers Association www.cellulose.org	(888) 881-2462 (937) 222-2462
CISCA	Ceilings & Interior Systems Construction Association www.cisca.org	(630) 584-1919
CISPI	www.cispi.org	
CLFMI	Chain Link Fence Manufacturers Institute	(301) 596-2583
CPA	Composite Panel Association www.pbmdf.com	(703) 724-1128
CRI	Carpet and Rug Institute (The) www.carpet-rug.com	(800) 882-8846 (706) 278-3176

CRRC	www.coolroofs.org	(510) 485-7175
CRSI	Concrete Reinforcing Steel Institute	(847) 517-1200
CRRC	Cool Roof Rating Council www.coolroofs.org	(866) 465-2523 (510) 485-7175
CSA	Canadian Standards Association www.csa.ca	(800) 463-6727 (416) 747-4000
CSA	(Formerly: IAS - International Approval Services) www.csa-international.org	(416) 747-4000
CSI	www.csinet.org	(703) 684-0300
CSSB	Cedar Shake & Shingle Bureau	(604) 820-7700
CTI	Cooling Technology Institute (Formerly: Cooling Tower Institute)	(281) 583-4087
DHI	Door and Hardware Institute www.dhi.org	(703) 222-2010
ECA	Electrical Components Association www.ec-central.org	(703) 907-8024
EIA	www.eia.org	
EIMA	EIFS Industry Members Association	(800) 294-3462
EJCDC	Engineers Joint Contract Documents Committee http://content.asce.org/ejcdc/	(703) 295-6000
EJMA	Expansion Joint Manufacturers Association, Inc. www.ejma.org	(914) 332-0040
ESD	(Electrostatic Discharge Association) www.esda.org	
ETL SEMCO	(Formerly: ITS - Intertek Testing Service NA) www.intertek-etlsemko.com	

FIBA	(The International Basketball Federation) www.fiba.com	
FIVB	(The International Volleyball Federation) www.fivb.ch	
FM Approvals	www.fmglobal.com	
FM Global	FM Global www.fmglobal.com	(401) 275-3000
FRSA	Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.	(407) 671-3772
FSA	Fluid Sealing Association www.fluidsealing.com	(610) 971-4850
FSC	Forest Stewardship Council www.fsc.org	49 228 367 66 0
GA	www.gypsum.org	(301) 277-8686
GANA	Glass Association of North America	(785) 271-0208
GRI	(Part of GSI)	
GS	www.greenseal.org	
GSI	Geosynthetic Institute	(610) 522-8440
HI	Hydronics Institute www.gamanet.org	(908) 464-8200
HI/GAMA	Hydronics Institute/Gas Appliance Manufacturers Association Division of Air-Conditioning, Heating, and Refrigeration Institute (AHRI) www.ahrinet.org	(908) 464-8200
HMMA	Hollow Metal Manufacturers Association (Part of NAAMM)	
HPVA		

	www.hpva.org	
HPW	H. P. White Laboratory, Inc.	(410) 838-6550
IAPSC	International Association of Professional Security Consultants www.iapsc.org	(515) 282-8192
ICBO	International Conference of Building Officials www.iccsafe.org	(888) 422-7233
ICEA	www.icea.net	
ICRI	International Concrete Repair Institute, Inc.	(847) 827-0830
ICPA	International Cast Polymer Association www.icpa-hq.org	(703) 525-0320
IEC	International Electrotechnical Commission www.iec.ch	41 22 919 02 11
IEEE	www.ieee.org	
IES	Illuminating Engineering Society of North America	(703) 525-0320
IEST	Institute of Environmental Sciences and Technology www.iest.org	(847) 255-1561
IGMA	Insulating Glass Manufacturers Alliance www.igmaonline.org	(613) 233-1510
ILI	www.iliai.com	
ISA	Instrumentation, Systems, and Automation Society, The	(919) 549-8411
ISO	International Organization for Standardization www.iso.ch	41 22 749 01 11
ISSFA	International Solid Surface Fabricators Association www.issfa.net	(877) 464-7732 (801) 341-7360
ITS	(Now ETL SEMCO)	
ITU	International Telecommunication Union	41 22 730 51 11

KCMA	Kitchen Cabinet Manufacturers Association www.kcma.org	(703) 264-1690
LGSEA	Light Gauge Steel Engineers Association www.arcat.com	(202) 263-4488
LMA	(Now part of CPA)	
LPI	Lightning Protection Institute	(800) 488-6864
MBMA	Metal Building Manufacturers Association www.mbma.com	(216) 241-7333
MCA	Metal Construction Association www.metalconstruction.org	(847) 375-4718
MFMA	www.maplefloor.org	
MFMA	Metal Framing Manufacturers Association, Inc.	(312) 644-6610
MH	Material Handling (Now MHIA)	
MHIA	Material Handling Industry of America www.mhia.org	(800) 345-1815 (704) 676-1190
MIA	www.marble-institute.com	
MPI	Master Painters Institute	(888) 674-8937
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc. www.mss-hq.com	(703) 281-6613
NAAMM	National Association of Architectural Metal Manufacturers www.naamm.org	(630) 942-6591
NACE	(National Association of Corrosion Engineers International) www.nace.org	(281) 228-6200
NADCA		

	www.nadca.com	
NAGWS	National Association for Girls and Women in Sport	(800) 213-7193, ext. 453
NAIMA	North American Insulation Manufacturers Association www.naima.org	(703) 684-0084
NBGQA	National Building Granite Quarries Association, Inc. www.nbgqa.com	(800) 557-2848
NCAA	www.ncaa.org	
NCMA	National Concrete Masonry Association	(703) 713-1900
NCTA	National Cable & Telecommunications Association www.ncta.com	(202) 222-2300
NEBB	National Environmental Balancing Bureau www.nebb.org	(301) 977-3698
NECA	www.necanet.org	
NeLMA	Northeastern Lumber Manufacturers' Association	(207) 829-6901
NEMA	National Electrical Manufacturers Association www.nema.org	(703) 841-3200
NETA	InterNational Electrical Testing Association www.netaworld.org	(888) 300-6382 (269) 488-6382
NFHS	www.nfhs.org	
NFPA	NFPA www.nfpa.org	(800) 344-3555
NFRC	National Fenestration Rating Council	(301) 589-1776
NGA	National Glass Association www.glass.org	(866) 342-5642 (703) 442-4890
NHLA	National Hardwood Lumber Association www.natlhardwood.org	(800) 933-0318 (901) 377-1818

NLGA	www.nlga.org	
NOFMA	NOFMA: The Wood Flooring Manufacturers Association www.nofma.org	(901) 526-5016
NOMMA	National Ornamental & Miscellaneous Metals Association	(888) 516-8585
NRCA	National Roofing Contractors Association www.nrca.net	(800) 323-9545 (847) 299-9070
NRMCA	National Ready Mixed Concrete Association www.nrmca.org	(888) 846-7622 (301) 587-1400
NSF	(National Sanitation Foundation International) www.nsf.org	(734) 769-8010
NSSGA	www.nssga.org	(703) 525-8788
NTMA	National Terrazzo & Mosaic Association, Inc. (The)	(800) 323-9736
NWFA	National Wood Flooring Association www.nwfa.org	(800) 422-4556 (636) 519-9663
PCI	Precast/Prestressed Concrete Institute www.pci.org	(312) 786-0300
PDI	www.pdionline.org	(978) 557-0720
PGI	PVC Geomembrane Institute	(217) 333-3929
PTI	Post-Tensioning Institute www.post-tensioning.org	(248) 848-3180
RCSC	Research Council on Structural Connections www.boltcouncil.org	
RFCI	www.rfci.com	(706) 882-3833
RIS	Redwood Inspection Service	
SAE	SAE International	(877) 606-7323

	www.sae.org	(724) 776-4841
SCAQMD	South Coast Air Quality Management District www.aqmd.com	(909) 396-2000
SCTE	www.scte.org	(610) 363-6888
SDI	Steel Deck Institute	(847) 458-4647
SDI	Steel Door Institute www.steeldoor.org	(440) 899-0010
SEFA	Scientific Equipment and Furniture Association www.sefalabs.com	(877) 294-5424 (516) 294-5424
SEI/ASCE	(See ASCE)	
SIA	Security Industry Association	(866) 817-8888
SJI	Steel Joist Institute www.steeljoist.org	(843) 626-1995
SMA	Screen Manufacturers Association www.smacentral.org	(561) 533-0991
SMACNA	National Association www.smacna.org	
SMPTE	www.smpte.org	
SPFA	Spray Polyurethane Foam Alliance www.sprayfoam.org	(800) 523-6154
SPIB	Southern Pine Inspection Bureau (The)	(850) 434-2611
SPRI	Single Ply Roofing Industry www.spri.org	(781) 647-7026
SSINA	Specialty Steel Industry of North America www.ssina.com	(800) 982-0355 (202) 342-8630
SSPC	www.sspc.org	(412) 281-2331

STI	Steel Tank Institute	(847) 438-8265
SWI	Steel Window Institute www.steelwindows.com	(216) 241-7333
SWPA	Submersible Wastewater Pump Association www.swpa.org	(847) 681-1868
TCA	www.tilt-up.org	
TCNA	Tile Council of North America, Inc.	(864) 646-8453
TEMA	Tubular Exchanger Manufacturers Association www.tema.org	(914) 332-0040
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance www.tiaonline.org	(703) 907-7700
TMS	www.masonrysociety.org	
TPI	Truss Plate Institute, Inc.	(703) 683-1010
TPI	Turfgrass Producers International www.turfgrassod.org	(800) 405-8873 (847) 649-5555
TRI	Tile Roofing Institute www.tilerroofing.org	(312) 670-4177
UL	www.ul.com	(847) 272-8800
UNI	Uni-Bell PVC Pipe Association	(972) 243-3902
USAV	USA Volleyball www.usavolleyball.org	(888) 786-5539 (719) 228-6800
USGBC	U.S. Green Building Council www.usgbc.org	(800) 795-1747
USITT	www.usitt.org	(315) 463-6463
WASTEC	Waste Equipment Technology Association	(800) 424-2869

WCLIB	West Coast Lumber Inspection Bureau www.wclib.org	(800) 283-1486 (503) 639-0651
WCMA	Window Covering Manufacturers Association www.wcmanet.org	(212) 297-2122
WDMA	(Formerly: NWWDA - National Wood Window and Door Association) www.wdma.com	(312) 321-6802
WI	www.wicnet.org	
WMMPA	Wood Moulding & Millwork Producers Association	(800) 550-7889
WSRCA	Western States Roofing Contractors Association www.wsrca.com	(800) 725-0333 (650) 570-5441
WWPA	Western Wood Products Association www.wwpa.org	(503) 224-3930

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

DIN	www.din.de	
IAPMO	International Association of Plumbing and Mechanical Officials	(909) 472-4100
ICC	International Code Council www.iccsafe.org	(888) 422-7233
ICC-ES	ICC Evaluation Service, Inc. www.icc-es.org	(800) 423-6587 (562) 699-0543

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

COE	Army Corps of Engineers www.usace.army.mil	
-----	---	--

CPSC	Consumer Product Safety Commission www.cpsc.gov	(800) 638-2772 (301) 504-7923
DOC	Department of Commerce www.commerce.gov	(202) 482-2000
DOD	Department of Defense http://dodssp.daps.dla.mil	(215) 697-6257
DOE	Department of Energy www.energy.gov	(202) 586-9220
EPA	Environmental Protection Agency	(202) 272-0167
FAA	Federal Aviation Administration www.faa.gov	(866) 835-5322
FCC	Federal Communications Commission www.fcc.gov	(888) 225-5322
FDA	www.fda.gov	
GSA	General Services Administration	(800) 488-3111
HUD	Department of Housing and Urban Development www.hud.gov	(202) 708-1112
LBL	Lawrence Berkeley National Laboratory www.lbl.gov	(510) 486-4000
NCHRP	(See TRB)	
NIST	National Institute of Standards and Technology	(301) 975-6478
OSHA	Occupational Safety & Health Administration www.osha.gov	(800) 321-6742 (202) 693-1999
PBS	Public Buildings Service (See GSA)	
PHS	http://www.hhs.gov/ophs/	
RUS	Rural Utilities Service	(202) 720-9540
SD	State Department	(202) 647-4000

FTMS Federal Test Method Standard
(See FS)

MIL

MIL-STD (See MILSPEC)

MILSPEC

Available from Department of Defense Single Stock Point
<http://dodssp.daps.dla.mil>

UFAS

Available from Access Board
www.access-board.gov

(202) 272-0080

F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

CBHF

www.dca.ca.gov/bhfti

(916) 574-2041

CCR California Code of Regulations

(916) 323-6815

CDHS California Department of Health Services
www.dhcs.ca.gov

(916) 445-4171

CDPH California Department of Public Health, Indoor Air Quality Section
www.cal-iaq.org

CPUC

www.cpuc.ca.gov

TFS Texas Forest Service

<http://txforests-service.tamu.edu>

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 4200

SECTION 01 5000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes requirements for temporary utilities, support facilities, toilets and security and protection facilities.

1.2 USE CHARGES

- A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Architect, consulting engineers, vendors, testing agencies, and authorities having jurisdiction.
- B. Water Service: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- C. Electric Power Service: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.3 SUBMITTALS

- A. Site Plan: Shows temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

1.4 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.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Portable Chain-Link Fencing: Minimum 2-inch, 9-gage, 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 and bottom rails. Provide either concrete or galvanized steel bases for supporting posts.

2.2 TEMPORARY FACILITIES

A. Field Offices, General:

1. Use of some portion of the building as field office is permissible. Coordinate location to not inhibit the work in area used as office.
2. If preferred by Contractor a prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading can be used. Cost for such facility should be part of Contractors general conditions.

B. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

C. Portable Toilets: Provide and maintain standard, easily cleanable and regularly serviced portable toilets for construction personnel. Construction personnel are strictly prohibited from using any existing lavatories on site.

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:

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
3. Permanent HVAC System: none.

PART 3 - EXECUTION

3.1 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 Division 01 Section "Summary."

3.2 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. Water Service: Use of Owner's existing water service facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
 - 1. Where installations below an outlet might be damaged by spillage or leakage, provide a drip pan of suitable size to minimize water damage. Drain accumulated water promptly from pans.
- C. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
- D. Electric Power Service: Use of Owner's existing electric power service will be permitted, as long as equipment is maintained in a condition acceptable to Owner.
- E. 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.
- F. Electronic Communication Service: Provide temporary electronic communication service, including electronic mail in field office.

3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
 - 1. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet of building lines. Comply with NFPA 241.
 - 2. Maintain support facilities until near 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: Use designated areas of Owner's existing parking areas for construction personnel.
- D. 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 Division 01 Section "Execution" for progress cleaning requirements.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Site Enclosure Fence: Before construction operations begin furnish and install staging area enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
 - 1. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Provide Owner with one set of keys. Owner will provide pass cards to building
- B. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.
- C. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- D. Temporary Floor Protection:
 - 1. General- Provide where needed.
- E. 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.
 - 1. Prohibit smoking in construction areas.
 - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
 - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

3.5 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, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

END OF SECTION 01 5000

SECTION 01 6000 - 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. Division 01 Section "Substitution Procedures" for requests for substitutions.
 - 2. Division 01 Section "References" for applicable industry standards for products specified.

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. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.4 ACTION SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
 - 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
 - a. Form of Approval: As specified in Division 01 Section "Submittal Procedures."
 - b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
 - 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 - 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 - 1. Schedule delivery to minimize long-term storage at 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 to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.
7. Provide a secure location and enclosure at 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 warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for 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 with the Specifications, prepare a written document using indicated form properly executed.
 3. See Divisions 02 through 33 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Division 01 Section "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 not in conflict with requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected," Architect will make selection.
 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
 6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
- B. Product Selection Procedures:
1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 3. Products:
 - a. Restricted List: 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.
 - b. Nonrestricted List: 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. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
 4. Manufacturers:
 - a. Restricted List: 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.
 - b. Nonrestricted List: 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.

Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.

5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and 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.
- C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Division 01 Section "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 similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 6000

SECTION 01 7300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. General installation of products.
 - 4. Progress cleaning.
 - 5. Starting and adjusting.
 - 6. Protection of installed construction.
 - 7. Correction of the Work.
- B. See Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.2 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.
 - 1. Before construction, verify the location and points of connection of utility services.
- B. Existing Utilities: 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 and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- C. Acceptance of Conditions: 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. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 2. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 3. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 4. 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 Owner 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. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. General: Engage a land surveyor, if new construction is not able to be laid out with reference to an existing structure as per the Floor or Site Plan, lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 3. Inform installers of lines and levels to which they must comply.
 4. Check the location, level and plumb, of every major element as the Work progresses.
 5. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 6. 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 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.
- 3.4 FIELD ENGINEERING (If needed due to 3.3-A above)
- A. 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.
- B. 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.
- C. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- D. Final Property Survey: Prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
1. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."
- 3.5 INSTALLATION
- A. General: 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.
- 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 the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
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.
- H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 PROGRESS CLEANING

- A. **General: Clean project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.**
1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

- 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 in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
 - G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
 - H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
 - I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
 - J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.
- 3.7 STARTING AND ADJUSTING
- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
 - B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.
 - C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 01 Section "Quality Requirements."

3.8 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.9 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 01 Section "Cutting and Patching."
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01 7300

SECTION 01 7700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Inspection procedures.
 - 2. Final cleaning.
 - 3. Operation and Maintenance Manuals.
- B. See Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
- C. See Divisions 02 through 33 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.2 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
 - 1. The Project Team will conduct an inspection of the work to identify if there is work that is deemed needing correction or is uncompleted. See paragraph B 'Inspection' below.
 - 2. Advise Owner of pending insurance changeover requirements.
 - 3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - a. Building Inspector's Certificate of Occupancy
 - b. Fire Marshall's Certificate of Fire Clearance
 - c. Elevator Inspector's final inspection
 - d. Boiler Inspector's final inspection
 - 5. Prepare and submit Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
 - 6. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 - 7. Provide equipment startup report.
 - 8. Submit test/adjust/balance records.
 - 9. Provide water disinfection report.

10. Provide attic stock material sign-off as described throughout the divisions (based on the square footage per material for the largest unit).
11. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
12. Advise Owner of changeover in heat and other utilities.
13. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
14. Complete final cleaning requirements, including touchup painting.
15. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Notify the Architect and Owner that the project is sufficiently complete for inspection for Substantial Completion. Upon notification, Architect will organize a site visit for those needing to inspect the work or notify Contractor of unfulfilled requirements. The Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items on Punch List that must be completed or corrected before certificate will be issued.

1. Project Team: A Punch List will be generated for items needing correction or yet to be completed for each of the disciplines listed below (which should constitute the full scope of the project):
 - a. Architect
 - b. Structural
 - c. Mechanical
 - d. Electrical
 - e. Data/Communication
 - f. Civil
 - g. Landscaping
2. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
3. Results of completed inspection will form the basis of requirements for Final Completion.

1.3 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:
1. Submit a final Application for Payment.
 2. Provide notification that each item, of the Punch List and all items listed under Substantial Completion has been completed or otherwise resolved for acceptance.
 3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
- B. Inspection: Notify the Architect and Owner that the project is ready for final inspection for acceptance. Upon notification, Architect will organize a site visit for those needing final inspection or notify Contractor of unfulfilled requirements. The Owner will notify the Contractor what construction must be completed or corrected before final certificate of payment will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.4 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Preparation: The architect will generate a copy of the list and submit this to the Contractor as soon as possible upon completion of the review. It will 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. The Punch List will:
 1. Organize list of spaces in sequential order.
 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
- B. The Owner will determine the amount of time that will be allotted to the Contractor for the completion of the List.

1.5 OPERATION AND MAINTENANCE MANUAL

- A. Manual: Provide (three) 3 copies: one for architect, two for the Owner. Organize information based on the table of contents of the Project Manual.
 1. Bind information in heavy-duty, 3-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 Division of the Project Manual. Mark tab to identify each Division. 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 "OPERATION AND MAINTENANCE MANUAL," Project name, name of Contractor, and date of Substantial Completion.
- B. Include:
 1. See Project Manual divisions 02 through 33 Sections for information of operation and maintenance procedures to be included.
 2. Contractor and Subcontractor list and information.
 3. Certificates of Agency Sign-offs as per paragraph 1.2-4(a) above.
 4. Balancing Report.
 5. Disinfectant Report.
 6. Record Product Data.
 7. Warranties.
- C. Submittal Time: Submit the copies of the Operations and Maintenance Manual within (twenty) 20 days of the Substantial Completion date.
- D. Warranties:

1. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
2. Under each divider of the Operation and Maintenance Manual provide a second divider that identifies the warranty documents for that particular item(s).

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. 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 portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, 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 neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. 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.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo 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. Replace chipped or broken glass and other damaged

- transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
- k. Remove labels that are not permanent.
 - l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
 - m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - n. Replace parts subject to unusual operating conditions.
 - o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - q. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
 - r. Leave Project clean and ready for occupancy.
- B. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 01 7700

SECTION 01 7823 - 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. Operation and maintenance documentation directory.
 - 2. Emergency manuals.
 - 3. Operation manuals for systems, subsystems, and equipment.
 - 4. Product maintenance manuals.
 - 5. Systems and equipment maintenance manuals.
- B. Related Requirements:
 - 1. Division 01 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
 - 2. Division 01 Section "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.
 - 3. Divisions 02 through 33 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

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. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect will comment on whether content of operations and maintenance submittals are acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

- B. Format: Submit operations and maintenance manuals in the following format:
1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
 - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - b. Enable inserted reviewer Comments on draft submittals.
 2. Three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Architect will return two copies.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.
1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
1. List of documents.
 2. List of systems.
 3. List of equipment.
 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- 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."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization: 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 contact information for Contractor.
 4. 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. 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: Enable bookmarking of 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.
- F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.
2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for each of the following:
 1. Type of emergency.
 2. Emergency instructions.
 3. Emergency procedures.
- B. 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.

- C. 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.
- D. Emergency Procedures: Include the following, as applicable:
 - 1. Instructions on stopping.
 - 2. Shutdown instructions for each type of emergency.
 - 3. Special operating instructions and procedures.

2.4 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
 - 1. Operating standards.
 - 2. Operating procedures.
 - 3. Wiring diagrams.
 - 4. Control diagrams.
 - 5. Precautions against improper use.
- B. Descriptions: Include the following:
 - 1. Product name and model number. Use designations for products indicated on Contract Documents.
 - 2. Manufacturer's name.
 - 3. Equipment function.
 - 4. Operating characteristics.
- C. Operating Procedures: Include the following, as applicable:
 - 1. Equipment or system break-in procedures.
 - 2. Routine and normal operating instructions.
 - 3. Normal shutdown instructions.
 - 4. Special operating instructions and procedures.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE MANUALS

- A. 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.
- B. 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.

- C. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
- D. 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. Schedule for routine cleaning and maintenance.
 - 4. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. 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.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. 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 warranty and bond information, as described below.
- B. 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.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
 - 1. Standard maintenance instructions and bulletins.
 - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 - 3. List of items recommended to be stocked as spare parts.
- D. 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. Aligning, adjusting, and checking instructions.
- E. 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.
- F. 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.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. 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 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. 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.
- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
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.

- E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, 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.
 - 1. 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.

- F. 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 operation and maintenance manuals.
 - 2. Comply with requirements of newly prepared record Drawings in Division 01 Section "Project Record Documents."

- G. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 01 7823

SECTION 01 7839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
- B. See Divisions 02 through 33 Sections for specific requirements for Project Record Documents of the Work in those Sections.
- C. See Division 01 Section 'Closeout Procedures' for submitting Record Product Data.

1.2 SUBMITTALS

- A. The following documents shall be submitted to the Architect within (ten) 10 calendar days of the date of Substantial Completion:
- B. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one (1) set of marked-up Record Prints.
- C. Record Specifications: Submit one (1) copy of marked-up Project's Specifications, including addenda and contract modifications.
- D. Record Product Data: Submit three (3) copies of each Product Data submittal. Include this data in the Operations and Maintenance Manual. See paragraph 1.5- Operations and Maintenance Manual found in Section 01 7700 'Closeout Procedures'.
 - 1. Organize as per the table of contents of the Project Manual.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.
 - 1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the 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. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
2. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
 3. Record Drawings need to state any changes as to "as-built" conditions, stating sizes, kind of materials, vital piping, conduit locations and similar matters. All notes of encountered or changed conditions shall be included.
 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 5. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize Record Prints and newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.
 3. Sign cover letter or Record Drawing cover sheet certifying that they show complete and exact "as-built conditions.

2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 4. Note related Change Orders and Record Drawings where applicable.
 5. Sign cover letter or Record Specifications cover sheet certifying that they show complete and exact "as-built conditions.

2.3 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 - 3. Note related Change Orders and Record Drawings where applicable.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.
- B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction 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.

END OF SECTION 01 7839

SECTION 01 9113 - 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. OPR and BoD documentation are included by reference for information only.

1.2 SUMMARY

- A. Section includes general requirements that apply to implementation of commissioning without regard to specific systems, assemblies, or components.
- B. Related Sections:
 - 1. Division 21 Section "Commissioning of Fire Suppression" for commissioning process activities for fire-suppression systems, assemblies, equipment, and components.
 - 2. Division 22 Section "Commissioning of Plumbing" for commissioning process activities for plumbing systems, assemblies, equipment, and components.
 - 3. Division 23 Section "Commissioning of HVAC" for commissioning process activities for HVAC&R systems, assemblies, equipment, and components.
 - 4. Division 25 Section "Commissioning of Integrated Automation" for commissioning process activities for integrated automation systems, assemblies, equipment, and components.
 - 5. Division 26 Section "Commissioning of Electrical Systems" for commissioning process activities for electrical systems, assemblies, equipment, and components.
 - 6. Division 28 Section "Commissioning of Electronic Safety and Security" for commissioning process activities for electronic safety and security systems, assemblies, equipment, and components.

1.3 DEFINITIONS

- A. BoD: Basis of Design. A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.
- B. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- C. CxA: Commissioning Authority.
- D. OPR: 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.

These include Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

- E. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 COMMISSIONING TEAM

- A. Members Appointed by Contractor(s): Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action. The commissioning team shall consist of, but not be limited to, representatives of Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.

1.5 OWNER'S RESPONSIBILITIES

- A. Provide the OPR documentation to the CxA and Contractor for information and use.
- B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.
- C. Provide the BoD documentation, prepared by Architect and approved by Owner, to the CxA and Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

1.6 CONTRACTOR'S RESPONSIBILITIES

- A. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:
 - 1. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
 - 2. Cooperate with the CxA for resolution of issues recorded in the Issues Log.
 - 3. Attend commissioning team meetings held on a variable basis.
 - 4. Integrate and coordinate commissioning process activities with construction schedule.
 - 5. Review and accept construction checklists provided by the CxA.
 - 6. Complete electronic construction checklists as Work is completed and provide to the Commissioning Authority on a weekly basis.
 - 7. Review and accept commissioning process test procedures provided by the Commissioning Authority.
 - 8. Complete commissioning process test procedures.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 9113

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.
- B. Related Sections:
 - 1. Section 312000 "Earth Moving" for drainage fill under slabs-on-grade.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Product Certificates: For materials manufactured within 100 miles (160 km) of Project, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each raw material.
 - 3. Product Data for Credit IEQ 4.3: For curing and sealing compounds, documentation including printed statement of VOC content.
 - 4. Design Mixtures for Credit ID 1.1: For each concrete mixture containing fly ash as a replacement for portland cement or other portland cement replacements, and for equivalent concrete mixtures that do not contain portland cement replacements.
- C. Design Mixtures: For each concrete mixture.
- D. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement.
- E. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.

1.3 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Material certificates.

- C. Material test reports.
- D. Floor surface flatness and levelness measurements.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."
- D. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- E. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- F. Preinstallation Conference: Conduct conference at Project site.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

2.2 STEEL REINFORCEMENT

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Reinforcing Bars: As indicated in the General Structural Notes.

- C. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.
- D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice.

2.3 CONCRETE MATERIALS

- A. Regional Materials: Concrete shall be manufactured within 100 miles (160 km) of Project site from aggregates and cementitious materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles (160 km) of Project site.
- B. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: As indicated in the General Structural Notes.
 - a. Fly Ash: As indicated in the General Structural Notes.
 - 2. Blended Hydraulic Cement: As indicated in the General Structural Notes.
- C. Normal-Weight Aggregates: As indicated in the General Structural Notes.
 - 1. Maximum Coarse-Aggregate Size: As indicated in the General Structural Notes.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Water: As indicated in the General Structural Notes.

2.4 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 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.

2.5 FIBER REINFORCEMENT

- A. Synthetic Micro-Fiber: Monofilament polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, 1/2 to 1-1/2 inches (13 to 38 mm) long.

2.6 WATERSTOPS

- A. Flexible Rubber Waterstops: CE CRD-C 513, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
- B. Chemically Resistant Flexible Waterstops: Thermoplastic elastomer rubber waterstops, for embedding in concrete to prevent passage of fluids through joints; resistant to oils, solvents, and chemicals. Factory fabricate corners, intersections, and directional changes.
- C. Flexible PVC Waterstops: CE CRD-C 572, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
- D. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch (19 by 25 mm).
- E. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch (10 by 19 mm).

2.7 VAPOR RETARDERS

- A. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.
- B. Sheet Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than 10 mils (0.25 mm) thick.

2.8 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.

- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
- F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
- G. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
 - 1. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- H. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
 - 1. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.9 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

2.10 CONCRETE MIXTURES

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
- B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
- D. Proportion normal-weight concrete mixture as follows:
 - 1. Minimum Compressive Strength: As indicated in the General Structural Notes.
 - 2. Maximum Water-Cementitious Materials Ratio: As indicated in the General Structural Notes.
 - 3. Slump Limit: As indicated in the General Structural Notes.

4. Air Content: As indicated in the General Structural Notes.
5. Air Content: As indicated in the General Structural Notes.
6. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

2.11 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.12 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, and furnish batch ticket information.
 1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- C. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- D. Chamfer exterior corners and edges of permanently exposed concrete.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 VAPOR RETARDERS

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
 1. Lap joints **6 inches (150 mm)** and seal with manufacturer's recommended tape.

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.5 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of **1/8 inch (3.2 mm)**. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut **1/8-inch- (3.2-mm-)** wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
- E. Waterstops: Install in construction joints and at other joints indicated according to manufacturer's written instructions.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
- C. Cold-Weather Placement: Comply with ACI 306.1.
- D. Hot-Weather Placement: Comply with ACI 301.

3.7 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces exposed to public view.
- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
 - 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
 - 2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
 - 3. Cork-Float Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of **1/4 inch (6 mm)** in one direction.
 - 1. Apply scratch finish to surfaces indicated and to receive concrete floor toppings.

- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
 - 1. Apply float finish to surfaces indicated to receive trowel finish.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 - 2. Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft.- (3.05-m-) long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch (6 mm).
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
 - 1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

3.9 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq.m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to

heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

- a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.10 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

3.11 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

END OF SECTION 033000

SECTION 034500 - PRECAST ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Architectural precast concrete sills and caps.
- B. Related Sections include the following:
 - 1. Division 04 Section "Unit Masonry" for brick setting materials and installation after precast concrete panel production.

1.3 DEFINITION

- A. Design Reference Sample: Sample of approved architectural precast concrete color, finish and texture, preapproved by Architect.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Sustainable Design Submittals:
 - 1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
 - 2. Product Certificates: For materials manufactured within 100 miles (160 km) of Project, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each raw material.
- C. Design Mixtures: For each precast concrete mixture. Include compressive strength and water-absorption tests.
- D. Shop Drawings: Detail fabrication and installation of architectural precast concrete units. Indicate locations, plans, elevations, dimensions, shapes, and cross sections of each unit. Indicate joints, reveals, and extent and location of each surface finish. Indicate details at building corners.
 - 1. Indicate separate face and backup mixture locations and thicknesses.

2. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
 3. Show units as noted in Drawings with shape, dimensions and joint thicknesses.
 4. Include plans and elevations showing unit location and sequence of erection for special conditions.
 5. Indicate location of each architectural precast concrete unit by same identification mark placed on panel.
 6. Indicate relationship of architectural precast concrete units to adjacent materials.
- E. Samples: For each type of finish indicated on exposed surfaces of architectural precast concrete units, in sets of 3, illustrating full range of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches.
1. When other faces of precast concrete unit are exposed, include Samples illustrating workmanship, color, and texture of backup concrete as well as facing concrete.
 - a. Grout Samples for Initial Selection: Color charts consisting of actual sections of grout showing manufacturer's full range of colors.
 - b. Grout Samples for Verification: Showing color and texture of joint treatment.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver architectural precast concrete units in such quantities and at such times to limit unloading units temporarily on the ground.
- B. Support units during shipment on non-staining shock-absorbing material.
- C. Store units with adequate dunnage and bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.
- D. Place stored units so identification marks are clearly visible, and units can be inspected.
- E. Handle and transport units in a position consistent with their shape and design in order to avoid excessive stresses which would cause cracking or damage.

1.6 SEQUENCING

- A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 - PRODUCTS

2.1 MOLD MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.
- B. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that will provide continuous and true precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.
 - 1. Mold-Release Agent: Commercially produced liquid-release agent that will not bond with, stain or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.
- C. Form Liners: Units of face design, texture, arrangement, and configuration. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.
- D. Surface Retarder: Chemical set retarder, capable of temporarily delaying final hardening of newly placed concrete mixture to depth of reveal specified.

2.2 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- C. Galvanized Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed bars, ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized.
- D. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from galvanized steel wire into flat sheets.
- E. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.
- F. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 117.

2.3 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type III, gray, unless otherwise indicated.
 - 1. For surfaces exposed to view in finished structure, mix gray with white cement, of same type, brand, and mill source.

- B. Supplementary Cementitious Materials:
1. Fly Ash: ASTM C 618, Class C or F, with maximum loss on ignition of 3 percent.
 2. Metakaolin Admixture: ASTM C 618, Class N.
 3. Silica Fume Admixture: ASTM C 1240, with optional chemical and physical requirement.
 4. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- C. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.
1. Face-Mixture-Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected finish sample.
 - a. Gradation: Uniformly graded.
 2. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand of same material as coarse aggregate, unless otherwise approved by Architect.
- D. Lightweight Aggregates: Except as modified by PCI MNL 117, ASTM C 330, with absorption less than 11 percent.
- E. Coloring Admixture: Submit color samples for Architect selection. ASTM C 979, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading.
- F. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.
- G. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
- H. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.
1. Water-Reducing Admixtures: 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. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.
 5. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 7. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017 M.

2.4 ACCESSORIES

- A. Reglets: Specified in Division 07 Section "Sheet Metal Flashing and Trim."

- B. Precast Accessories: Provide clips, hangers, plastic or steel shims, and other accessories required to install architectural precast concrete units.

2.5 GROUT MATERIALS

- A. Sand-Cement Grout: Portland cement, ASTM C 150, Type I, and clean, natural sand, ASTM C 144 or ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- B. Nonmetallic, Non-shrink Grout: Premixed, nonmetallic, noncorrosive, non-staining grout containing selected silica sands, Portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, Grade A for dry-pack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time.

2.6 CONCRETE MIXTURES

- A. Prepare design mixtures for each type of precast concrete required.
 - 1. Limit use of fly ash and silica fume to 20 percent of Portland cement by weight; limit metakaolin and silica fume to 10 percent of Portland cement by weight.
- B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at architectural precast concrete fabricator's option.
- C. Coloring Admixture: As selected by Architect. Submit colors for Architects selection.
- D. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 117 when tested according to ASTM C 1218/C 1218M.
- E. Normal-Weight Concrete Mixtures: Proportion full-depth mixture by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 5000 psi minimum.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
- F. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to PCI MNL 117.
- G. Lightweight Concrete Backup Mixtures: Proportion mixtures by either laboratory trial batch or field test data methods according to ACI 211.2, with materials to be used on Project, to provide lightweight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 5000 psi.
 - 2. Unit Weight: Calculated equilibrium unit weight of 115 lb/cu. ft., plus or minus 3 lb/cu. ft., according to ASTM C 567.
- H. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.

- I. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

2.7 MOLD FABRICATION

- A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing and de-tensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.
 1. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concrete placement. Coat form liner with form-release agent.
- B. Maintain molds to provide completed architectural precast concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.
 1. Form joints are not permitted on faces exposed to view in the finished work.
 2. Edge and Corner Treatment: Uniformly radiused.

2.8 FABRICATION

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during pre-casting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
 1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."
- B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing architectural precast concrete units to supporting and adjacent construction.
- C. Cast-in reglets, slots, holes, and other accessories in architectural precast concrete units as indicated on the Contract Drawings.
- D. Cast-in openings larger than 10 inches in any dimension. Do not drill or cut openings or prestressing strand without Architect's approval.
- E. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating, placing, and supporting reinforcement.
 1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcing exceeds limits specified in ASTM A 775/A 775M, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.

2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
 3. Place reinforcement to maintain at least 3/4-inch minimum coverage. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
 4. Place reinforcing steel and prestressing strand to maintain at least 3/4-inch minimum concrete cover. Increase cover requirements for reinforcing steel to 1-1/2 inches when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
 5. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.
- F. Reinforce architectural precast concrete units to resist handling, transportation, and erection stresses.
- G. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
- H. Place face mixture to a minimum thickness after consolidation of the greater of 1 inch or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover specified.
- I. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units.
1. Place backup concrete mixture to ensure bond with face-mixture concrete.
- J. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air on surfaces. Use equipment and procedures complying with PCI MNL 117.
1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."
- K. Comply with PCI MNL 117 for hot- and cold-weather concrete placement.
- L. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.

- M. Discard and replace architectural precast concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 117 and Architect's approval.

2.9 FABRICATION TOLERANCES

- A. Fabricate architectural precast concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished panel complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.
- B. Fabricate architectural precast concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished panel complies with the following product tolerances:
 - 1. Overall Height and Width of Units, Measured at the Face Exposed to View: As follows:
 - a. 10 feet or under, plus or minus 1/8 inch.
 - b. 10 to 20 feet, plus 1/8 inch, minus 3/16 inch.
 - c. 20 to 40 feet, plus or minus 1/4 inch.
 - d. Each additional 10 feet, plus or minus 1/16 inch.
 - 2. Overall Height and Width of Units, Measured at the Face Not Exposed to View: As follows:
 - a. 10 feet or under, plus or minus 1/4 inch.
 - b. 10 to 20 feet, plus 1/4 inch, minus 3/8 inch.
 - c. 20 to 40 feet, plus or minus 3/8 inch.
 - d. Each additional 10 feet, plus or minus 1/8 inch.
 - 3. Total Thickness or Flange Thickness: Plus 1/4 inch, minus 1/8 inch.
 - 4. Rib Thickness: Plus or minus 1/8 inch.
 - 5. Rib to Edge of Flange: Plus or minus 1/8 inch.
 - 6. Distance between Ribs: Plus or minus 1/8 inch.
 - 7. Variation from Square or Designated Skew (Difference in Length of the Two Diagonal Measurements): Plus or minus 1/8 inch per 72 inches or 1/2 inch total, whichever is greater.
 - 8. Length and Width of Block-outs and Openings within One Unit: Plus or minus 1/4 inch.
 - 9. Location and Dimension of Block-outs Hidden from View and Used for HVAC and Utility Penetrations: Plus or minus 3/4 inch.
 - 10. Dimensions of Haunches: Plus or minus 1/4 inch.
 - 11. Haunch Bearing Surface Deviation from Specified Plane: Plus or minus 1/8 inch.
 - 12. Difference in Relative Position of Adjacent Haunch Bearing Surfaces from Specified Relative Position: Plus or minus 1/4 inch.
 - 13. Bowing: Plus or minus L/360, maximum 1 inch.
 - 14. Local Smoothness: 1/4 inch per 10 feet.
 - 15. Warping: 1/16 inch per 12 inches of distance from nearest adjacent corner.
 - 16. Tipping and Flushness of Plates: Plus or minus 1/4 inch.
 - 17. Dimensions of Architectural Features and Rustications: Plus or minus 1/8 inch.

- C. Position Tolerances: For cast-in items measured from datum line location, as indicated on Shop Drawings.
1. Weld Plates: Plus or minus 1 inch.
 2. Inserts: Plus or minus 1/2 inch.
 3. Handling Devices: Plus or minus 3 inches.
 4. Reinforcing Steel and Welded Wire Fabric: Plus or minus 1/4 inch where position has structural implications or affects concrete cover; otherwise, plus or minus 1/2 inch.
 5. Reinforcing Steel Extending out of Member: Plus or minus 1/2 inch of plan dimensions.
 6. Tendons: Plus or minus 1/4 inch, vertical; plus or minus 1 inch, horizontal.
 7. Location of Rustication Joints: Plus or minus 1/8 inch.
 8. Location of Opening within Panel: Plus or minus 1/4 inch.
 9. Location of Flashing Reglets: Plus or minus 1/4 inch.
 10. Location of Flashing Reglets at Edge of Panel: Plus or minus 1/8 inch.
 11. Reglets for Glazing Gaskets: Plus or minus 1/8 inch.
 12. Electrical Outlets, Hose Bibs: Plus or minus 1/2 inch.
 13. Location of Bearing Surface from End of Member: Plus or minus 1/4 inch.
 14. Allowable Rotation of Plate, Channel Inserts, and Electrical Boxes: 2-degree rotation or 1/4 inch maximum over the full dimension of unit.
 15. Position of Sleeve: Plus or minus 1/2 inch.
 16. Location of Window Washer Track or Buttons: Plus or minus 1/8 inch.

2.10 FINISHES

- A. Finish exposed surfaces of architectural precast concrete units by smooth, steel-trowel finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Do not install precast concrete units until supporting cast-in-place building structural framing has attained minimum allowable design compressive strength or supporting steel or other structure is complete.

3.2 INSTALLATION

- A. Erect architectural precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment as units are being permanently connected.
 - 1. Install temporary steel or plastic spacing shims or bearing pads as precast concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
 - 2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
 - 3. Remove projecting lifting devices and grout fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
 - 4. Unless otherwise indicated, maintain uniform joint widths of 3/4 inch.
- B. Grouting Connections: Grout connections where required or indicated. Retain grout in place until hard enough to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces. Keep grouted joints damp for not less than 24 hours after initial set. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.

3.3 ERECTION TOLERANCES

- A. Erect architectural precast concrete units level, plumb, square, true, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.
- B. Erect architectural precast concrete units level, plumb, square, and true, without exceeding the following noncumulative erection tolerances:
 - 1. Plan Location from Building Grid Datum: Plus or minus 1/2 inch.
 - 2. Plan Location from Centerline of Steel: Plus or minus 1/2 inch.
 - 3. Top Elevation from Nominal Top Elevation: As follows:
 - a. Exposed Individual Panel: Plus or minus 1/4 inch.
 - b. Non-Exposed Individual Panel: Plus or minus 1/2 inch.
 - c. Exposed Panel Relative to Adjacent Panel: 1/4 inch.
 - d. Non-Exposed Panel Relative to Adjacent Panel: 1/2 inch.
 - 4. Support Elevation from Nominal Support Elevation: As follows:
 - a. Maximum Low: 1/2 inch.
 - b. Maximum High: 1/4 inch.
 - 5. Maximum Plumb Variation over the Lesser of Height of Structure or 100 Feet: 1 inch.
 - 6. Plumb in Any 10 Feet of Element Height: 1/4 inch.
 - 7. Maximum Jog in Alignment of Matching Edges: 1/4 inch.
 - 8. Joint Width (Governs over Joint Taper): Plus or minus 1/4 inch.
 - 9. Maximum Joint Taper: 3/8 inch.

10. Joint Taper in 10 Feet: 1/4 inch.
11. Maximum Jog in Alignment of Matching Faces: 1/4 inch.
12. Differential Bowing or Camber, as Erected, between Adjacent Members of Same Design: 1/4 inch.
13. Opening Height between Spandrels: Plus or minus 1/4 inch.

3.4 REPAIRS

- A. Repair architectural precast concrete units if permitted by Architect. The Architect reserves the right to reject repaired units that do not comply with requirements.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet.
- C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780.
- D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
- E. Remove and replace damaged architectural precast concrete units when repairs do not comply with requirements.

3.5 CLEANING

- A. Clean surfaces of precast concrete units exposed to view.
- B. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.
- C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Clean soiled precast concrete surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. Protect other work from staining or damage due to cleaning operations.
 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION 034500

SECTION 042200 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units (CMU's).
2. Decorative concrete masonry units.
3. Pre-faced concrete masonry units.
4. Steel reinforcing bars.
5. Masonry-cell insulation.

1.2 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

1. Concrete Masonry Unit Test: For each type of unit required, according to ASTM C 140 for compressive strength.
2. Mortar Test (Property Specification): For each mix required, according to ASTM C 109/C 109M for compressive strength.
3. Mortar Test (Property Specification): For each mix required, according to ASTM C 780 for compressive strength.
4. Grout Test (Compressive Strength): For each mix required, according to ASTM C 1019.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

C. Shop Drawings: For reinforcing steel. Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.

D. Samples: For each type and color of exposed masonry unit and colored mortar.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type and size of product indicated. For masonry units include material test reports substantiating compliance with requirements.
- B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
 - 1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
 - 2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

1.5 QUALITY ASSURANCE

- A. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.
- B. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.
 - 1. Build sample panels for typical exterior and interior walls in sizes approximately 60 inches (1500 mm) long by 48 inches (1200 mm) high by full thickness.

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. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
- B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.
- B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.2 CONCRETE MASONRY UNITS

- A. Regional Materials: CMUs shall be manufactured within 500 miles (800 km) of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.
- B. Shapes: Provide shapes indicated and for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
- C. Integral Water Repellent: Provide units made with liquid polymeric, integral water repellent admixture that does not reduce flexural bond strength for exposed units and where indicated.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ACM Chemistries, Inc.; RainBloc.
 - b. BASF Aktiengesellschaft; Rheopel Plus.
 - c. Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block.
- D. CMUs: ASTM C 90.
 - 1. Unit Compressive Strength: As indicated in the General Structural Notes.
 - 2. Density Classification: As indicated in the General Structural Notes.
- E. Concrete Building Brick: ASTM C 55.
- F. Decorative CMUs: ASTM C 90.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Sunroc Corporation, 1570 West 200 North St Orem, Utah 84057.
 - b. Amcor Masonry Products, 333 South Redwood Road, North Salt Lake, Utah 84054.
 - 2. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi (19.3 MPa) or as indicated in Structural Drawings.
 - 3. Density Classification: Normal weight.
 - 4. Pattern and Texture:
 - a. 4inch x 8inch x 16inch integral color CMU veneer.
 - b. 4inch x 8inch x 16inch "L" corner (8inch return) integral color CMU veneer.
 - c. 8inch x 8inch x 16inch integral color.
 - 5. Color:
 - a. Field – HONED FACE As selected from manufactures full range of colors – submit samples for review.
 - b. Accent Band – HONED FACE as selected from manufactures full range of colors – submit samples for review.

2.3 LINTELS

- A. General: Provide one of the following:
- B. Steel Angle Lintels: provide structural steel angle lintel at all opening heads per structural detail.

2.4 MORTAR AND GROUT MATERIALS

- A. Regional Materials: Aggregate for mortar and grout, shall be extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.
- B. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- C. Hydrated Lime: ASTM C 207, Type S.
- D. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- E. Mortar Cement: ASTM C 1329.

- 1. Products: Subject to compliance with requirements, provide the following:

- a. Lafarge North America Inc.; Lafarge Mortar Cement or Magnolia Superbond Mortar Cement.

- F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.

- 1. Products: Subject to compliance with requirements, provide one of the following. Submit color for Architect selection:

- a. Davis Colors; True Tone Mortar Colors.
- b. Lanxess Corporation; Bayferrox Iron Oxide Pigments.
- c. Solomon Colors, Inc.; SGS Mortar Colors.

- G. Colored Cement Product: 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. Products: Subject to compliance with requirements, provide one of the following. Submit color for Architect selection:

- 1) Capital Materials Corporation; Riverton Portland Cement Lime Custom Color.
- 2) Holcim (US) Inc.; Rainbow Mortamix Custom Color Cement/Lime.
- 3) Lafarge North America Inc.; Eaglebond Portland & Lime.

- 4) Lehigh Cement Company; Lehigh Custom Color Portland/Lime Cement.
2. Colored Masonry Cement:
 - a. Products: Subject to compliance with requirements, provide one of the following. Submit color for Architect selection:
 - 1) Capital Materials Corporation; Flamingo Color Masonry Cement.
 - 2) Cemex S.A.B. de C.V.; Richcolor Masonry Cement.
 - 3) Essroc, Italcementi Group; Brixment-in-Color.
 - 4) Holcim (US) Inc.; Rainbow Mortamix Custom Color Masonry Cement.
 - 5) Lafarge North America Inc.; U.S. Cement Custom Color Masonry Cement.
 - 6) Lehigh Cement Company; Lehigh Custom Color Masonry Cement.
 - 7) National Cement Company, Inc.; Coosa Masonry Cement.
- H. Aggregate for Mortar: ASTM C 144.
 1. For joints less than 1/4 inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
 2. White-Mortar Aggregates: Natural white sand or crushed white stone.
 3. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
 - I. Aggregate for Grout: ASTM C 404.
 - J. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
 1. Products: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Euclid Chemical Company (The); Accelguard 80.
 - b. Grace Construction Products, W. R. Grace & Co. - Conn.; Morset.
 - c. Sonneborn Products, BASF Aktiengesellschaft; Trimix-NCA
 - K. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs, containing integral water repellent by same manufacturer.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ACM Chemistries, Inc.; RainBloc for Mortar.
 - b. BASF Aktiengesellschaft; Rheopel Mortar Admixture.
 - c. Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.
 - L. Water: Potable.

2.5 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).
- B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.
 - 1. Wire Size for Veneer Ties: 0.187-inch (4.76-mm) diameter.
 - 2. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches (407 mm) o.c.
 - 3. Provide in lengths of not less than 10 feet (3 m), with prefabricated corner and tee units.

2.6 TIES AND ANCHORS

- A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.
 - 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.
 - 2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
 - 3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

2.7 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing complying with Section 076200 "Sheet Metal Flashing and Trim and as follows:
 - 1. Metal Drip Edge: Fabricate from stainless steel. Extend at least 3 inches (76 mm) into wall and 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.
 - 2. Metal Sealant Stop: Fabricate from stainless steel. Extend at least 3 inches (76 mm) into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch (19 mm) and down into joint 1/4 inch (6 mm) to form a stop for retaining sealant backer rod.
 - 3. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 inch (1.02 mm).
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Advanced Building Products Inc.; Peel-N-Seal.
 - 2) Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.
 - 3) Dayton Superior Corporation, Dur-O-Wal Division; Dur-O-Barrier Thru-Wall Flashing.
 - 4) Fiberweb, Clark Hammerbeam Corp.; Aquaflash 500.
 - 5) Grace Construction Products, W. R. Grace & Co. - Conn.; Perm-A-Barrier Wall Flashing.

- 6) Heckmann Building Products Inc.; No. 82 Rubberized-Asphalt Thru-Wall Flashing.
 - 7) Hohmann & Barnard, Inc.; Textroflash.
 - 8) W. R. Meadows, Inc.; Air-Shield Thru-Wall Flashing.
 - 9) Polyguard Products, Inc.; Polyguard 400.
 - 10) Sandell Manufacturing Co., Inc.; Sando-Seal.
 - 11) Williams Products, Inc.; Everlastic MF-40.

 - 12) .Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy.
- b. Products: Subject to compliance with requirements, provide one of the following:
- 1) DuPont; Thru-Wall Flashing.
 - 2) Hohmann & Barnard, Inc.; Flex-Flash.
 - 3) Hyload, Inc.; Hyload Cloaked Flashing System.
 - 4) Mortar Net USA, Ltd.; Total Flash.
4. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D 4637, 0.040 inch (1.0 mm) thick.
- a. Products: Subject to compliance with requirements, provide one of the following:
- 1) Carlisle Coatings & Waterproofing; Pre-Kleened EPDM Thru-Wall Flashing.
 - 2) Firestone Specialty Products; FlashGuard.
 - 3) Heckmann Building Products Inc.; No. 81 EPDM Thru-Wall Flashing.
 - 4) Hohmann & Barnard, Inc.; Epra-Max EPDM Thru-Wall Flashing.
 - 5) Sandell Manufacturing Co., Inc.; EPDM Flashing.
- B. Single-Wythe CMU Flashing System: System of CMU cell flashing pans and interlocking CMU web covers made from high-density polyethylene incorporating chemical stabilizers that prevent UV degradation. Cell flashing pans have integral weep spouts that are designed to be built into mortar bed joints and weep collected moisture to the exterior of CMU walls and that extend into the cell to prevent clogging with mortar.
1. Products: Subject to compliance with requirements, provide one of the following:
- a. Mortar Net USA, Ltd.; Blok-Flash.
- C. Solder and Sealants for Sheet Metal Flashings: As specified in Section 076200 "Sheet Metal Flashing and Trim."
- D. 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.

2.8 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Pre-molded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; formulated from neoprene urethane or PVC.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

2.9 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.
 - 2. Use portland cement-lime or mortar cement mortar unless otherwise indicated.
 - 3. For exterior masonry, use portland cement-lime or mortar cement mortar.
 - 4. For reinforced masonry, use portland cement-lime or mortar cement mortar.
 - 5. 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 C 270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated.
 - 1. For masonry below grade or in contact with earth, use Type S.
 - 2. For reinforced masonry, use Type S.
 - 3. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
 - 4. For interior non-load-bearing partitions, Type O may be used instead of Type N.
- D. Pigmented Mortar: Use colored cement product.
 - 1. Pigments shall not exceed 10 percent of portland cement by weight.
 - 2. Pigments shall not exceed 5 percent of masonry cement or mortar cement by weight.
 - 3. Application: Use pigmented mortar for exposed mortar joints with the following units:
 - a. Decorative CMUs.
 - b. Pre-faced CMUs.

- 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. Application: Use colored aggregate mortar for exposed mortar joints with the following units. Submit color for Architect selection:
 - a. Decorative CMUs.
 - b. Pre-faced CMUs.
- F. Grout for Unit Masonry: Comply with ASTM C 476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
 2. Proportion grout in accordance with ASTM C 476, paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa).
 3. Provide grout with a slump of 8 to 11 inches (203 to 279 mm) as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 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 (12 mm) or minus 1/4 inch (6 mm).
2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
2. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm).

3.2 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. 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. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
- 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.
- F. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
- G. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.3 MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs as follows:
 1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
 3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
 4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.4 FLASHING

- A. General: Install embedded flashing in masonry at lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
- B. Install flashing as follows unless otherwise indicated:
 - 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
 - 2. At lintels, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.
 - 3. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal drip edge.
 - 4. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
- C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

3.5 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
 - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

3.6 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
- B. Inspections: Level 2 special inspections according to the "International Building Code."
 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Frequency: One set of tests for each 5000 sq. ft. (464 sq. m) of wall area or portion thereof.
- D. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- E. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.
- F. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.
- G. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

3.7 MASONRY WASTE DISPOSAL

- A. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
 1. Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.
- B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042200

SECTION 04 7300 – SIMULATED STONE VENEER

PART 1 - GENERAL

1.1 SUMMARY

- A. Related Documents: General and Supplementary Conditions of the Contract, Division 1 General Requirements, and Drawings are applicable to this Section.
- B. Section Includes:
 - 1. Simulated stone veneers for interior and exterior applications.
 - 2. Reinforcement, anchorages, mortar, and accessories.
- C. Related Sections:
 - 1. Section 06 1000 – Rough Carpentry
 - 2. Section 07 2500 - Weather Barriers
 - 3. Section 07 6200 – Sheet Metal Flashing and Trim
 - 3. Section 07 9200 – Joint Sealants: Sealant joints
 - 4. Section 09 2400 – Portland Cement Plastering

1.2 SUBMITTALS

- A. Submit following in accordance with Section 013300.
 - 1. Product Data: Submit for fabricated wire reinforcement and each type of stone specified. Include all applicable physical and performance data.
 - 2. Samples: Submit 1, 3 feet x 4 feet samples of simulated stone units to illustrate color, texture, and size range of each type unit.
 - 3. Manufacturer's detailed installation instructions including all preparation required for substrate sheathing.
 - 4. Certifications listed in Quality Assurance article of Part 1 this Section.

1.3 FIELD SAMPLES

- A. Sample Installation: Construct stone wall at job site 3 feet x 4 feet in size, including mortar, special shapes, bonding, joint work, reinforcement, moisture barrier, grouting, corbelling, mortar color, expansion, control joints, and accessories.
 - 1. Obtain Architect's approval before beginning work. Protect and retain sample as a basis on which the quality of the work will be judged. Do not remove until Substantial Completion.
 - 2. Accepted Field Sample: May not remain as part of completed Work.

1.4 QUALITY ASSURANCE

- A. Installer: Minimum 5 years experience in similar types of work of similar scope and be able

to furnish list of previous jobs and references if requested by Architect.

- B. Fabricator: Licensee of manufacturer with not less than 5 years experience manufacturing simulated stone products of size, type, and quantity as required for this project.
- C. Expansion Joints: Provide expansion joints as indicated on Drawings or, if not indicated, install at frequency and in accordance with details and as recommended by manufacturer. Confirm locations and frequency with Architect before beginning work.
- D. Certifications:
 - 1. Provide written documentation that products have met or exceeded at least one of the following certifications for a minimum of 10 years:
 - a. ICBO – International Conference of Building Officials;
 - b. SBCCI – Southern Building Code Congress International;
 - c. BOCA – Building Officials and Code Administrators International; or
 - d. ICC-International Code Council.
 - 2. Provide written documentation that stone products comply with specified minimum criteria when tested in accordance with testing standards specified in Part 2 of this Section.

1.5 PROJECT CONDITIONS

A. Environmental Requirements:

- 1. Minimum air temperature (of substrate and ambient temperature) of 40 degrees F (4 degrees C) prior to, during, and for 48 hours after completion of work; and
- 2. Cold Weather Requirements: IMIAC (International Masonry Industry All-Weather Council) - Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, handle, and protect materials.

- 1. Store mortar materials on pallets in dry place.
- 2. Protect materials from rain, moisture, and freezing temperatures.
- 3. Protect reinforcement and accessories from elements.

1.7 WARRANTY

A. Limited Warranty:

1. Provide 50-year limited warranty against manufacturing defects in manufactured stone products.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Harristone.
 - a. G. S. Harris Co. Inc.
2810 Pennsylvania Avenue
Ogden, UT 84401
(888) 878-6631
(801) 621-1380 Fax: (801) 621-8252
[E-mail: info@harristone.com](mailto:info@harristone.com); www.harristone.com
- B. Stone Product: Subject to compliance with requirements, provide the following product:
 1. Stone Styles: BIRCHWOOD DRY STONE - Grouted or CAPE COD CHIEF JOSEPH - Grouted as manufactured by Harristone.
 2. Products
 - a. Basis of Design: Stone Color: BIRCHWOOD or CAPE COD as manufactured by Harristone. Note: Other manufacturers and stone colors will be acceptable to the Architect. Provide substitutions of equal quality for the Owner and Architect's review and approval.
 - b. Submit for color selection

2.2 STONE MATERIALS

- A. Simulated Stone:
 1. Precast simulated stone, composed of following materials:
 - a. Portland Cement: ASTM C 150, Type 1, 2, or 3 depending upon color to be produced.
 - b. Course Aggregates: ASTM C 330, lightweight type, color as necessary to obtain final approved color of stone.
 - c. Sand: ASTM C 144, special color if required to match approved sample.
 - d. Iron oxide colors.
 - e. Water: Clean and free from deleterious substances.
- B. Stone Accessories:
 1. Provide the following accessory and accent stones:
 - a. Corner pieces- see Drawings for locations and details.

2.3 MORTAR MATERIALS

- A. Tilesetter's Thin-set: Mix thin-set (tile-setter's) into mortar in accordance with manufacturer's instructions for dry stack applications. Formula: 1/2 part thin-set, 1 part cement, 2-1/2 parts sand.
- B. Mixing: Use thin-set with acrylic additive in accordance with thin-set manufacturer's recommendation.
 - 1. Thoroughly mix mortar and grout ingredients in quantities needed for immediate use. Mix grout to ASTM C 270, Type S proportions and mortar to ASTM C 270, Type S requirements.
 - 2. Do not use anti-freeze compounds to lower freezing point of mortar.

2.4 RELATED MATERIALS

- A. Setting Accessories:
 - 1. Moisture Barrier:
 - a. ASTM D 226, No. 15 non-perforated asphalt saturated organic felt. Coordinate with simulated stone veneer manufacturer.
 - 2. Metal Lath: ASTM C 847; 18 gauge, galvanized, flat diamond mesh, self furring, stamped sheet; 2.5.
 - a. Attachment: Galvanized nails, screws and other metal supports, of type and size to suit applications; to rigidly secure materials in place.
 - 3. Joint Sealant: Refer to Section 079200.
 - 4. Fasteners: Coated 1-1/2inch nails, staples, or screws of type and for spacing as recommended by simulated stone manufacturer.
 - 5. Cleaner: Nonacid cleaner as recommended by simulated stone manufacturer.
 - 6. Metal flashings: refer to Section 07 6200.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

- A. Examination: Examine conditions and proceed with work in accordance with Section 014000.
 - 1. Verify that field conditions are acceptable and are ready to receive work.
 - 2. Verify items provided by other Sections of work are properly sized and located.
 - 3. Verify that built-in items are in proper location and ready for roughing

into masonry work.

4. Verify correct product prior to installation.
5. Consult Owner and manufacturer if deficiencies exist. Correct deficiencies in accordance with stone manufacturer's recommendations.

B. Protect surrounding area from possible damage during installation work.

C. Initiating installation constitutes Installer's acceptance of existing surfaces and substrate.

3.2 APPLICATION

A. Moisture Barrier:

1. Apply sheets horizontally, starting at the base of the wall, and lapping each successive upper sheet over the previous lower sheet. Provide two layers of moisture barrier.
2. Lap horizontal and vertical joints 6 inches.
3. Cut and seal joints, penetrations, openings, and projections with manufacturer's recommended tape.
4. Install with corrosion-resistant staples.

B. Install Rain Screen barrier between Moisture Barrier and exterior finish.

C. Simulated Stone Veneer: Install in accordance with manufacturer's instructions.

D. Plan work to minimize jobsite cutting. Perform necessary cutting with proper tools to provide uniform edges; take care to prevent breaking unit corners or edges.

E. Remove excess mortar; do not allow mortar to dry on face of units.

1. Point and tool joints before mortar has set.
2. Clean and finish joints in accordance with architect's and manufacturer's instructions.

F. Control Joints: Size in accordance with Section 07920 for sealant performance, but in no case larger than adjacent mortar joints in exposed stone units.

G. Expansion Joints: Provide where indicated on Drawings or as recommended by system manufacturer.

H. Built-in Work: As work progresses, build in door and window frames, nailing strips, anchor bolts, plates, and other items specified in various sections.

1. Build in items plumb and level.
2. Bed anchors of metal door and glazed frames in mortar joints. Fill frame voids solid with mortar.
3. Do not build in organic materials subject to deterioration.

3.3 ADJUSTING

- A. Cutting and Fitting: Cut and fit for chases, pipes, conduit, sleeves, and grounds. Cooperate with other sections of work to provide correct size, shape, and location.
 - 1. Obtain approval prior to cutting or fitting any area not indicated or where appearance or strength of masonry work may be impaired.

3.4 CLEANING

- A. Cleaning:
 - 1. Remove excess mortar and smears using brush or steel wool.
 - 2. Replace defective mortar. Match adjacent work.
 - 3. Clean soiled surfaces with non-acidic solution, acceptable to the stone manufacturer, which will not harm masonry or adjacent materials.
 - 4. Leave surfaces thoroughly clean and free of mortar and other soiling.
 - 5. Use nonmetallic tools in cleaning operations.

END OF SECTION 047300

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes structural steel.
- B. Related Sections:
 - 1. Section 051213 "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.

1.2 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.3 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand loads indicated and comply with other information and restrictions indicated.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Laboratory Test Reports for Credit IEQ 4: For primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: Show fabrication of structural-steel components.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified fabricator.

- B. Welding certificates.
- C. Mill test reports for structural steel, including chemical and physical properties.
- D. Source quality-control reports.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Comply with applicable provisions of the following specifications and documents:
 - 1. AISC 303.
 - 2. AISC 360.
 - 3. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- E. Preinstallation Conference: Conduct conference at Project site.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 50 percent.
- B. W-Shapes: As indicated in the General Structural Notes.
- C. Channels, Angles As indicated in the General Structural Notes.
- D. Plate and Bar: As indicated in the General Structural Notes.
- E. Cold-Formed Hollow Structural Sections: As indicated in the General Structural Notes.
- F. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
- G. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: As indicated in the General Structural Notes.

- B. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers.
 - 1. Finish: Hot-dip zinc coating.
- C. Unheaded Anchor Rods: As indicated in the General Structural Notes.
 - 1. Configuration: **Hooked**.
 - 2. Finish: As indicated in the General Structural Notes.
- D. Threaded Rods: ASTM A 36/A 36M
 - 1. Finish: Plain.

2.3 PRIMER

- A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Primer: Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- C. Primer: SSPC-Paint 25, Type I, zinc oxide, alkyd, linseed oil primer.
- D. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

2.4 GROUT

- A. Metallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.
- B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
- B. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
 - 2. Surfaces to be field welded.
 - 3. Surfaces to be high-strength bolted with slip-critical connections.
 - 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 - 5. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - 1. SSPC-SP 2, "Hand Tool Cleaning."
 - 2. SSPC-SP 3, "Power Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.8 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- C. Bolted Connections: Shop-bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

- D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
1. Liquid Penetrant Inspection: ASTM E 165.
 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 3. Ultrasonic Inspection: ASTM E 164.
 4. Radiographic Inspection: ASTM E 94.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Base Bearing and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 2. Weld plate washers to top of baseplate.
 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.3 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 1. Joint Type: Snug tightened.

- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.
- B. Bolted Connections: Bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 Bolts."
- C. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.
 - 1. In addition to visual inspection, field welds will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
- D. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

END OF SECTION 051200

SECTION 05 5000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Miscellaneous steel framing and supports.
2. Shelf angles.
3. Loose bearing and leveling plates.
4. Steel weld plates and angles.
5. Metal bollards.
6. Loose steel lintels.
7. Metal Ladders.

B. Related Sections:

1. Division 09 Sections "Exterior Painting", "Interior Painting" and "High-Performance Coatings" for surface preparation and priming requirements.

1.2 SUBMITTALS

A. Product Data: For the following:

1. Grout.

B. Shop Drawings: Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

C. Templates: For anchors and bolts.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Products: Subject to compliance with requirements, provide one of the products specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

B. METAL FABRICATORS AND SHOP DRAWINGS

1. AMFAB Steel Specialties, North Salt Lake, UT

2. Blue Star Steel, Salt Lake City, UT
3. CO Building Systems Inc., Ephriam, UT
4. JT Steel, Inc., West Jordan, UT
5. Lundahl Ironworks Comp., Franklin, ID
6. Nucor Building Systems, Brigham City, UT
7. Reliance Metal Center
8. SME Steel Contractors, West Jordan, UT
9. Tech-Steel, Inc., Clearfield, UT
10. T&M Manufacturing Inc., Tremonton, UT

2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces without blemishes.
- B. Ferrous Metals:
 1. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
 2. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
 3. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
 4. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
 5. Rolled-Stainless-Steel Floor Plate: ASTM A 793.
 6. Steel Tubing: ASTM A 500, cold-formed steel tubing.
 7. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.
 8. Slotted Channel Framing: Cold-formed metal channels complying with MFMA-3, 1-5/8 by 1-5/8 inches. Channels made from galvanized steel complying with ASTM A 653/A 653M, structural steel, Grade 33, with G90 coating; 0.079-inch nominal thickness.

2.3 FASTENERS

- A. General: Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at exterior walls. Provide stainless-steel fasteners for fastening aluminum. Select fasteners for type, grade, and class required.
- B. Cast-in-Place Anchors in Concrete: Threaded or wedge type; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.

2.4 MISCELLANEOUS MATERIALS

- A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107.

- B. Concrete Materials and Properties: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.

2.5 FABRICATION

- A. General: Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces.
 - 1. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.
 - 2. Weld corners and seams continuously. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals. Obtain fusion without undercut or overlap. Remove welding flux immediately. Finish exposed welds smooth and blended.
 - 3. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.
 - 4. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
 - 5. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, not less than 24 inches o.c.
- B. Miscellaneous Framing and Supports: Provide steel framing and supports not specified in other Sections as needed to complete the Work. Fabricate units from steel shapes, plates, and bars of welded construction. Cut, drill, and tap units to receive hardware, hangers, and similar items.
 - 1. Fabricate steel girders for wood frame construction from continuous steel shapes. Where wood nailers are attached to girders with bolts or lag screws, drill holes at 24 inches o.c.
 - 2. Fabricate steel pipe columns for supporting wood frame construction with steel baseplates and top plates welded to pipe with fillet welds the same size as pipe wall thickness.
- C. Loose Steel Lintels: Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.
 - 1. Lintels in Exterior Walls: Prime with zinc-rich primer.
- D. Shelf Angles: Fabricate shelf angles of sizes indicated and for attachment to framing. Fabricate with horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c.
 - 1. Shelf Angles in Exterior Walls: Prime with zinc-rich primer.
 - 2. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.
- E. Loose Bearing and Leveling Plates: Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts.
- F. Metal Bollards: Fabricate from Schedule 80 steel pipe.

1. See detail for fabrication and pipe size.

G. Metal Roof Ladders: Comply with latest IMC requirements for permanent roof ladder.

1. The side railing shall extend above the parapet or roof edge not less than 30 inches. (Using safety post to comply with this requirement)
2. Ladders shall have rung spacing not to exceed 14 inches on center. The upper most rung shall be a maximum of 24 inches below the upper edge of the roof hatch, roof or parapet, as applicable.
3. Ladders shall have a toe spacing not less than 6 inches deep.
4. There shall be a minimum of 18 inches between rails.
5. Rungs shall have a minimum of 0.75-inch diameter and be capable of withstanding a 300-pound load.
6. Ladders over 30 feet in height shall be provided with offset sections and landings capable of withstanding 100 pounds per square foot. Landing dimensions shall be not less than 18 inches and not less than the width of the ladder served. A guard rail shall be provided on all open sides of the landing.
7. Climbing clearance. The distance from the centerline of the rungs to the nearest permanent object on the climbing side of the ladder shall be a minimum of 30 inches measured perpendicular to the rungs. This distance shall be maintained from the point of the ladder access to the bottom of the hatch. A minimum clear width of 15-inches shall be provided on both sides of the ladder measured from the midpoint of and parallel with rungs except where cages or wells are installed.
8. Landing required. The ladder shall be provided with a clear unobstructed bottom landing area having a minimum dimension of 30 inches by 30 inches centered in front of the ladder.
9. Ladders shall be protected against corrosion by approved means.
10. Access to ladders shall be provided at all times.

2.6 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Finish metal fabrications after assembly.
- B. Refer to Division 09 Sections "Exterior Painting", "Interior Painting" and "High-Performance Coatings" for paint products and systems for metals.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, with edges and surfaces level, plumb, and true.
 1. Fit exposed connections accurately together. Weld connections that are not to be left as exposed joints but cannot be shop welded. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication.

2. Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction.
 3. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- B. Set bearing and leveling plates on cleaned surfaces using wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts and pack solidly with nonshrink, nonmetallic grout.
- C. Bollards:
1. Anchor bollards in place with concrete footings. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.
 2. Fill bollards solidly with concrete, mounding top surface to shed water.
- D. Roof Ladders:
1. Coordinate with roof hatch and install of safety post.
 2. Coordinate with wall support/blocking.
- E. Finishes:
1. Refer to Division 09 Sections "Exterior Painting", "Interior Painting" and "High-Performance Coatings" for paint products and systems for metal substrates.
 2. Finishes Schedule:
 - a. Miscellaneous steel framing and supports.
 - b. Shelf angles.
 - c. Loose bearing and leveling plates.
 - d. Steel weld plates and angles.
 - e. Loose steel lintels:
 - 1) Galvanize and paint as per Latex System in Div 09 Section "Exterior Painting".
 - f. Metal Bollards:
 - 1) Paint as per "Exterior Steel Substrate System" in Div 09 Section "High-Performance Coatings".
 - g. Metal Ladders.
 - 1) Paint as per "Interior Steel Substrate System" in Div 09 Section "High-Performance Coatings".
- F. Touch up surfaces and finishes after erection:
1. Painted Surfaces: Clean field welds, bolted connections, and abraded areas and touch up paint with the same material as used for shop painting.
 2. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 5000

SECTION 05 5213 - 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 Sections:

- 1. Division 06 Section "Rough Carpentry" for wood blocking for anchoring railings.
 - 2. Division 09 Sections "High-Performance Coatings" for surface preparation and priming requirements and painting.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

- B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:

- 1. Steel: 72 percent of minimum yield strength.

- C. Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

- 1. Handrails and Top Rails of Guards:

- a. Uniform load of 50 lbf/ ft. applied in any direction.
 - b. Concentrated load of 200 lbf applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.

- 2. Infill of Guards:

- a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
 - b. Infill load and other loads need not be assumed to act concurrently.

- D. 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.
- E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Manufacturer's product lines of mechanically connected railings.
 - 2. Railing brackets.
 - 3. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Verification: For each type of exposed finish required.
 - 1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
 - 2. Fittings and brackets.
 - 3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.
 - a. Show method of finishing and connecting members at intersections.
- D. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.
- C. Welding certificates.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.8 COORDINATION AND SCHEDULING

- 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.

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 are not limited to, the following:
 - 1. AMFAB Steel Specialties, North Salt Lake, UT
 - 2. Blue Star Steel, Salt Lake City, UT
 - 3. CO Building Systems Inc., Ephriam, UT
 - 4. JT Steel, Inc., West Jordan, UT
 - 5. Lundahl Ironworks Comp., Franklin, ID
 - 6. Nucor Building Systems, Brigham City, UT
 - 7. SME Steel Contractors, West Jordan, UT
 - 8. Tech-Steel, Inc., Clearfield, UT
 - 9. T&M Manufacturing Inc., Tremonton, UT

2.2 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.

2.3 STEEL AND IRON

- A. Tubing: ASTM A 500 (cold formed) or ASTM A 513.
- B. Pipe: ASTM A 53/A 53M, 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 A 36/A 36M.

2.4 FASTENERS

- A. General: Provide the following:
 - 1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941, 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 concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
 - 3. 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 six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.

2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Shop Primers: Provide primers that comply with Division 09 Painting Sections and Division 09 Section "High-Performance Coatings."

- C. Intermediate Coats and Topcoats: Provide products that comply with Division 09 Section "High-Performance Coatings."
- D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.6 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 as detailed in the Drawings.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- 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 will be exposed to weather in a manner to exclude 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 welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 1. 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: 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.
 - K. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
 - L. Close exposed ends of railing members with prefabricated end fittings.
 - M. 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.
 - N. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
 - O. 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.
 - P. For railing posts set in concrete, provide steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.
 - Q. For removable railing posts, fabricate slip-fit sockets from steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.
 1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.
 - R. 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.
- 2.7 FINISHES, GENERAL
- A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
 - B. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.8 STEEL AND IRON FINISHES

- A. Shop and Paint Finish: Comply with Section 09 9600 "High-Performance Coatings".

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 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 have been 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. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 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.

3.4 ANCHORING POSTS

- A. Use metal sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. 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 nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- C. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.
- D. Leave anchorage joint exposed with 1/8-inch buildup, sloped away from post.
- E. 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 flanges to post and bolt to metal supporting surfaces.
- F. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.5 ATTACHING RAILINGS

- A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends or connected to railing ends using nonwelded connections.
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends or connected to railing ends using nonwelded connections.
- C. Attach railings to wall with wall brackets, except where end flanges are used. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
 - 1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
 - 2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- D. Secure wall brackets and railing end flanges to building construction as follows:
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - 2. For hollow masonry anchorage, use toggle bolts.
 - 3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
 - 4. For steel-framed partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.

5. For steel-framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.
6. For steel-framed partitions, use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

3.6 ADJUSTING AND CLEANING

- A. Clean by washing thoroughly with clean water and soap and rinsing with clean water.
- B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- C. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09 Section "High-Performance Coatings."

3.7 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 05 5213

SECTION 06 1053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Rooftop equipment bases and support curbs.
2. Wood blocking, cants, and nailers.
3. Plywood backing panels.

- B. Related Requirements:

1.3 DEFINITIONS

- A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.
- B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 1. NeLMA: Northeastern Lumber Manufacturers' Association.
 2. NHLA: National Hardwood Lumber Association.
 3. NLGA: National Lumber Grades Authority.
 4. SPIB: The Southern Pine Inspection Bureau.
 5. WCLIB: West Coast Lumber Inspection Bureau.
 6. WWPA: Western Wood Products Association.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber 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, GENERAL

- A. Maximum Moisture Content of Lumber: 19 percent for 2-inch nominal thickness or less, no limit for more than 2-inch nominal thickness unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
 - 2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. 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. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
 - 4. Wood framing members that are less than 18 inches above the ground in crawl spaces or unexcavated areas.
 - 5. Wood floor plates that are installed over concrete slabs-on-grade.
- D. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
- E. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.
- F. Application: Treat items indicated on Drawings, and the following:
 - 1. Framing for raised platforms.
 - 2. Concealed blocking.
 - 3. Roof framing and blocking.
 - 4. Wood cants, nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing.
 - 5. Plywood backing panels.

2.3 DIMENSION LUMBER FRAMING

- A. Non-Load-Bearing Interior Partitions: Construction or No. 2 grade and the following species:
 - 1. Western woods; WCLIB or WWPA.
- B. Other Framing: Construction or No. 2 grade and the following species:
 - 1. Douglas fir-larch; WCLIB or WWPA.

2.4 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Rooftop equipment bases and support curbs.
 - 4. Cants.
 - 5. Furring.
 - 6. Grounds.
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber and the following species:
 - 1. Western woods; WCLIB or WWPA.
- C. For concealed boards, provide lumber with 19 percent maximum moisture content and the following species and grades:
 - 1. Western woods, Construction or No. 2 Common grade; WCLIB or WWPA.
- D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.5 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: DOC PS 1, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.
 - 1. Plywood shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile

Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.6 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M .
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Screws for Fastening to Metal Framing: ASTM C 1002 , length as recommended by screw manufacturer for material being fastened.
- F. Lag Bolts: ASME B18.2.1.
- G. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
- H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
 - 2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

2.7 METAL FRAMING ANCHORS

- A. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.
 - 1. Use for interior locations unless otherwise indicated.
- B. Hot-Dip Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.
 - 1. Use for wood-preservative-treated lumber and where indicated.
- C. Stainless-Steel Sheet: ASTM A 666, Type 304 .

1. Use for exterior locations and where indicated.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- B. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- C. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.
- E. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- F. Do not splice structural members between supports unless otherwise indicated.
- G. 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.
- H. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
 1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
 2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.
 3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
 4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.
- I. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere

with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

- J. 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.
- K. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
 - 3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
- L. 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 WOOD GROUND, BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
- C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 1053

SECTION 06 1600 - SHEATHING

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. Sheathing joint and penetration treatment.

- B. Related Requirements:

- 1. Section 07 2500 "Weather Barriers" for water-resistive barrier applied over wall sheathing.

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.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

- 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory."

2.2 WALL SHEATHING

- A. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corporation; GlasRoc.
 - b. G-P Gypsum Corporation; Dens-Glass Gold.
 - c. National Gypsum Company; Gold Bond e(2)XP.
 - d. Temple-Inland Inc.; GreenGlass
 - e. United States Gypsum Co.; Securock.
 2. Type and Thickness: Type X, 5/8 inch thick.
 3. Size: 48 by 108 inches for vertical installation.

2.3 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.

2.4 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

- A. Sealant for Glass-Mat Gypsum Sheathing: Elastomeric, medium-modulus, neutral-curing silicone joint sealant compatible with joint substrates formed by gypsum sheathing and other materials, recommended by sheathing manufacturer for application indicated and complying with requirements for elastomeric sealants specified in Section 07 9200 "Joint Sealants."
- B. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.
1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

2.5 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Framing: Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.
 - 1. Adhesives shall have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
 - 3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's "International Residential Code for One- and Two-Family Dwellings."
- D. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-253 and with manufacturer's written instructions.
 - 1. Fasten gypsum sheathing to wood framing with screws.
 - 2. Fasten gypsum sheathing to cold-formed metal framing with screws.

3. Install boards with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
 4. Install boards with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
- C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent boards without forcing. Abut ends of boards over centers of studs, and stagger end joints of adjacent boards not less than one stud spacing. Attach boards at perimeter and within field of board to each steel stud.
1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.
 2. For sheathing under stucco cladding, boards may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.
- D. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.
1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.
 2. For sheathing under stucco cladding, boards may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.
- E. Seal sheathing joints according to sheathing manufacturer's written instructions.
1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
 2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel silicone emulsion sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

END OF SECTION 06 1600

SECTION 06 4023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

- 1. Interior standing and running trim.
- 2. Interior frames and jambs.
- 3. Railings.

- B. Related Sections include the following:

- 1. Division 06 Section "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.
- 2. Division 06 Section "Finish Carpentry" for interior carpentry exposed to view that is not specified in this Section.
- 3. Division 12 Section "Residential Casework" for kitchen cabinets, vanity cabinets, plastic laminate countertops and backsplashes.

1.3 DEFINITIONS

- A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.
- B. Rough carriages for stairs are a part of interior architectural woodwork. Platform framing, headers, partition framing, and other rough framing associated with stairwork are specified in Division 06 Section "Rough Carpentry."

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

- 1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.

- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show details full size.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
3. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets and other items installed in architectural woodwork.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and fabricator.
- B. Product Certificates: For each type of product, signed by product manufacturer.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- B. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork with sequence-matched wood veneers and wood doors with face veneers that are sequence matched with woodwork and transparent-finished wood doors that are required to be of same species as woodwork.
- C. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
 1. Provide AWI Quality Certification Program labels and certificates indicating that woodwork, including installation, complies with requirements of grades specified.
- D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 17 and 50 percent during the remainder of the construction period.
- C. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
 - 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.9 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Wood Species and Cut for Transparent Finish: As Selected by Architect.
- C. Wood Species for Opaque Finish: As Selected by Architect.
- D. Wood Products: Comply with the following:
 - 1. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
 - 2. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde.
 - 3. Softwood Plywood: DOC PS 1, Medium Density Overlay.

2.2 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
- C. Adhesives, General: Adhesives shall not contain urea formaldehyde.
- D. VOC Limits for Installation Adhesives: Installation adhesives shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Wood Glues: 30 g/L.
 - 2. Multipurpose Construction Adhesives: 70 g/L.
 - 3. Contact Adhesive: 250 g/L.
- E. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
 - 1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.3 FABRICATION, GENERAL

- A. Interior Woodwork Grade: Unless otherwise indicated, provide Custom-grade interior woodwork complying with referenced quality standard.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- D. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
 - 1. Edges of Rails and Similar Members More Than 3/4 Inch Thick: 1/8 inch.

2.4 INTERIOR STANDING AND RUNNING TRIM FOR OPAQUE FINISH

- A. Grade: Economy.
- B. Wood Species: Any closed-grain hardwood or MDF.
- C. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.
- D. Assemble casings in plant except where limitations of access to place of installation require field assembly.

- E. Assemble moldings in plant to maximum extent possible. Miter corners in plant and prepare for field assembly with bolted fittings designed to pull connections together.

2.5 INTERIOR FRAMES AND JAMBS FOR OPAQUE FINISH

- A. Grade: Economy.
- B. Wood Species: Eastern white pine, sugar pine, or western white pine.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.
- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

- A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
- B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.
- C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.
- D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.
- F. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- G. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 96 inches long, except where shorter single-length pieces are necessary.
 - 1. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base if finished.

2. Install wall railings on indicated metal brackets securely fastened to wall framing.
 3. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches.
- H. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 2. Maintain veneer sequence matching of cabinets with transparent finish.
 3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with No. 10 wafer-head screws sized for 1-inch penetration into wood framing, blocking, or hanging strips.
- I. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 3. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c. and.
 4. Calk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants."
- J. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.
- K. Refer to Division 09 Sections for final finishing of installed architectural woodwork not indicated to be shop finished.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 06 4023

2. Running Trim: Generally combined in the term "standing and running trim" and refers to random, longer length trims delivered to the jobsite (e.g., baseboard, chair rail, crown molding).

1.3 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
 - a. Include materials used, standing and running trim profiles, joint details, and hardware.
2. Samples:
 - a. Interior MDF Paint Finish:
 - 1) Before performing work of this Section, prepare Control Sample, to match sample available from Owner, to be used as finishing standard for interior paint as specified in Section 09 9123.
 - 2) Design Criteria:
 - a) Provide 6 inch by 10 inch (200 mm by 255 mm) sample of pre-primed MDF.
 - b) Control Sample will be used as performance standard for evaluating finish provided.

B. Informational Submittals:

1. Source Quality Control Submittals:
 - a. Samples:
 - 1) Interior MDF pre-primed trim with field painted finish.

1.4 WARRANTY

A. Manufacturer Extended Warranty:

1. Approved Fabricator's written guarantee that all Goods and Services will be free from defects in materials and workmanship for a period of five (5) years from date of substantial completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Manufacturers:

1. Approved Fabricators. Basis-Of-Design Weyerhaeuser

B. Performance / Design Criteria: Conform to requirements of Section 06 4001 'Common Architectural Woodwork Requirements'.

1. Glue: Waterproof and of best quality.
2. Field applied-finish as specified in Section 09 9123.

C. Architectural Wood Trim:

1. Interior MDF pre-primed with field applied painted finish:
 - a. Design Criteria:
 - 1) 6" nominal x Continuous with square edge all four sides

2.2 SOURCE QUALITY CONTROL

A. Inspections:

1. Painted Finished MDF:

- a. Field painted as per Interior paint section 09 123

PART 3 - EXECUTION:

3.1 Installation:

- A. In areas where MDF base trim is installed adjacent to a sealed concrete floor finish the bottom edge of the MDF base trim shall have continuous clear sealant installed to protect the base trim against moisture during maintenance of the sealed concrete floor finish

END OF SECTION

SECTION 07 1326 - SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Modified bituminous sheet waterproofing, fabric reinforced.

1.3 FIELD CONDITIONS

- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.

- 1. Do not apply waterproofing in snow, rain, fog, or mist.

- B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.4 WARRANTY

- A. Manufacturer's Warranty: Manufacturer's standard materials-only warranty in which manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.

- 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Source Limitations for Waterproofing System: Obtain waterproofing materials molded-sheet drainage panels from single source from single manufacturer.

2.2 MODIFIED BITUMINOUS SHEET WATERPROOFING

- A. Modified Bituminous Sheet: Minimum 60-mil nominal thickness, self-adhering sheet consisting of 56 mils of rubberized asphalt laminated on one side to a 4-mil-thick, polyethylene-film reinforcement, and with release liner on adhesive side.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Protecto Wrap Company ; PW-100/60. or a comparable product by one of the following:
 - a. American Hydrotech, Inc.
 - b. Carlisle Coatings & Waterproofing Inc.
 - c. Henry Company.
 - d. Polyguard Products, Inc.
 - e. Tamko Building Products, Inc.
 2. Physical Properties:
 - a. Tensile Strength, Membrane: 250 psi minimum; ASTM D 412, Die C, modified.
 - b. Ultimate Elongation: 300 percent minimum; ASTM D 412, Die C, modified.
 - c. Low-Temperature Flexibility: Pass at minus 20 deg F; ASTM D 1970.
 - d. Crack Cycling: Unaffected after 100 cycles of 1/8-inch movement; ASTM C 836.
 - e. Puncture Resistance: 40 lbf minimum; ASTM E 154.
 - f. Water Absorption: 0.2 percent weight-gain maximum after 48-hour immersion at 70 deg F; ASTM D 570.
 - g. Water Vapor Permeance: 0.05 perms maximum; ASTM E 96/E 96M, Water Method.
 - h. Hydrostatic-Head Resistance: 200 feet minimum; ASTM D 5385.
 3. Sheet Strips: Self-adhering, rubberized-asphalt strips of same material and thickness as sheet waterproofing.

2.3 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.
- B. Primer: Liquid solvent-borne primer recommended for substrate by sheet-waterproofing material manufacturer.
- C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by sheet-waterproofing material manufacturer.
- D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, of trowel grade or low viscosity.
- E. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating.

- F. Metal Termination Bars: Aluminum bars, approximately 1 by 1/8 inch thick, predrilled at 9-inch centers.

2.4 MOLDED-SHEET DRAINAGE PANELS

- A. Molded-Sheet Drainage Panel: Comply with Section 33 4600 "Subdrainage."
- B. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Composite subsurface drainage panel consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 sieve laminated to one side of the core; and with a vertical flow rate of 9 to 15 gpm per ft..
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Protecto Wrap Company ; Protecto Drain 2000-V. or a comparable product by one of the following:
 - a. American Hydrotech, Inc; Hydrodrain 400.
 - b. Carlisle Coatings & Waterproofing Inc; CCW MiraDRAIN 6000.
 - c. Grace Construction Products; W.R. Grace & Co. -- Conn; Hydroduct 220.

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 waterproofing.
 - 1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
 - 2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
 - 3. Verify that compacted subgrade is dry, smooth, sound, and ready to receive waterproofing sheet.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. 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.
- E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
 - 1. Install sheet strips of width according to manufacturer's written instructions and center over treated construction and contraction joints and cracks exceeding a width of 1/8 inch for modified bituminous deck-paving waterproofing.
- F. Bridge and cover isolation joints discontinuous deck-to-wall and deck-to-deck joints with overlapping sheet strips of widths according to manufacturer's written instructions.
 - 1. Invert and loosely lay first sheet strip over center of joint. Firmly adhere second sheet strip to first and overlap to substrate.
- G. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.
 - 1. Install membrane strips centered over vertical inside corners. Install 3/4-inch fillets of liquid membrane on horizontal inside corners and as follows:
 - a. At footing-to-wall intersections, extend liquid membrane in each direction from corner or install membrane strip centered over corner.
 - b. At plaza-deck-to-wall intersections, extend liquid membrane or sheet strips onto deck waterproofing and to finished height of sheet flashing.
- H. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to ASTM D 6135.

3.3 MODIFIED BITUMINOUS SHEET-WATERPROOFING APPLICATION

- A. Install modified bituminous sheets according to waterproofing manufacturer's written instructions and recommendations in ASTM D 6135.
- B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.
- C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch-minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.
 - 1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F.
- D. Two-Ply Application: Install sheets to form a membrane with lap widths not less than 50 percent of sheet widths, to provide a minimum of two thicknesses of sheet membrane over areas to receive waterproofing.

- E. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.
- F. Seal edges of sheet-waterproofing terminations with mastic.
- G. Install sheet-waterproofing and auxiliary materials to tie into adjacent waterproofing.
- H. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches beyond repaired areas in all directions.
- I. Immediately install protection course with butted joints over waterproofing membrane.
 - 1. Molded-sheet drainage panels may be used in place of a separate protection course to vertical applications when approved by waterproofing manufacturer and installed immediately.

3.4 MOLDED-SHEET DRAINAGE-PANEL INSTALLATION

- A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesives or other methods that do not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

3.5 PROTECTION, REPAIR, AND CLEANING

- A. Do not permit foot or vehicular traffic on unprotected membrane.
- B. Protect waterproofing from damage and wear during remainder of construction period.
- C. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.
- D. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 07 1326

SECTION 07 2100 - 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. Foam-plastic board insulation.
2. Glass-fiber blanket insulation.
3. Mineral-wool blanket insulation.
4. Loose-fill insulation.
5. Exterior wall vapor retarders.

B. Related Sections:

1. Section 07 2500 "Weather Barriers" for membrane protection.
2. Section 07 5400 "Ethylene Interpolymer (KEE) Roofing for insulation specified as part of roofing construction.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Product Data: For adhesives, indicating VOC content.
3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for Low-emitting materials.

- 4. Laboratory Test Reports: For insulation, indicating compliance with requirements for low-emitting materials.
 - C. Schedule: Provide a schedule indicating the insulation product used for each application, the thickness, and the R-value required. See the schedule at the end of this section.
 - D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.
 - E. Research/Evaluation Reports: For foam-plastic insulation, from ICC-ES.
- 1.4 QUALITY ASSURANCE
- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- 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 before installation time.
 - 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. Basis-of-Design Product: The design is based on the product named in the basis-of-design and within the Construction Drawings. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified and based on substitution request approval.
- B. See Div 01 Section 01 2500 for "Substitution Procedures".

2.2 FOAM-PLASTIC BOARD INSULATION

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and minimum compressive strength indicated below, with maximum flame-spread and smoke-developed indexes of 5 and 45-175, respectively, per ASTM E 84.
- B. Below Grade: Type IV, 25-psi minimum
 - 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. Owens Corning.
 - b. Dow Chemical Company (The).
 - c. DiversiFoam Products
 - d. Pactiv Building Products
 - 2. See Insulation Schedule at the end of this Section for Basis-of-Design product and manufacturer.
- C. Continuous Wall Insulation: Type X, 16-psi minimum, ASTM C203
 - 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. Owens Corning.

- b. Dow Chemical Company (The).
 - c. DiversiFoam Products
 - d. Pactiv Building Products
2. See Insulation Schedule at the end of this Section for Basis-of-Design product and manufacturer.
- D. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.
1. Adhesives shall have a VOC content of 70 g/L or less.
 2. Adhesive shall 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".

2.3 GLASS-FIBER BLANKET INSULATION

- A. Insulation shall comply 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. Recycled Content: postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 percent.
- C. Manufacturers: See Insulation Schedule at the end of this Section for Basis-of-Design product and manufacturer. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. CertainTeed Corporation.
 2. Guardian Building Products, Inc.
 3. Johns Manville.
 4. Knauf Insulation.
 5. Owens Corning.
- D. Unfaced, Glass-Fiber Blanket 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.

- E. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:
 - 1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
 - 2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.

2.4 MINERAL-WOOL BLANKET INSULATION

- A. Insulation shall comply 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. Recycled Content: postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 percent
- C. Manufacturers: See Insulation Schedule at the end of this Section for Basis-of-Design product and manufacturer. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Fibrex Insulations Inc.
 - 2. Owens Corning.
 - 3. Roxul Inc.
 - 4. Thermafiber.
- D. Unfaced, Mineral-Wool Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

2.5 LOOSE FILL INSULATION

- A. Insulation shall comply 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. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 percent.
- C. Related Materials:
 - 1. Basis-of-Design: OPTIMA non-woven fabric or an equivalent having the following properties:
 - a. Frazier air permeability = 420 cfm ft². at 0.5" H₂O
 - b. Coulter average maximum pore size: 200 micrometers.
 - c. Grab tensile strength, lb./inch, average: MD: 22, CD:22.

2.6 VAPOR RETARDERS

- A. Basis-of-Design Sheet Retarder: Certainteed MemBrain, The SMART Vapor Retarder. Polyimide film vapor retarder for use with unfaced, vapor permeable glass fiber and mineral wool insulation in wall and ceiling cavities. Material has a permeance of 1 perm or less when tested to ASTM E 86, dry cup method and increases to greater than 10 perms using the wet cup method or a comparable product.
 - 1. Water Vapor Permeance:
 - a. ASTM E 86, dry cup method: 1.0 perms.
 - b. ASTM E 86, wet cup method: 10.0 perms.
 - 2. Fire Hazard Classification: ASTM E 84:
 - a. Maximum Flame Spread Index; 20.
 - b. Maximum Smoke Developed Index; 55.
- B. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
- C. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.
- D. Single-Component Nonsag Urethane Sealant: ASTM C 920, Type I, Grade NS, Class 25; Use NT related to exposure, and Use O related to vapor-barrier-related substrates.

- E. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and has demonstrated capability to bond vapor retarders securely to substrates indicated.

2.7 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position indicated with self-locking washer in place.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AGM Industries, Inc.; Series T TACTOO Insul-Hangers.
 - b. Gemco; Spindle Type.
 - 2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - 3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation indicated.
- B. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches square or in diameter.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AGM Industries, Inc.; RC150.
 - b. Gemco; R-150.
 - 2. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:
 - a. Ceiling plenums.
 - b. Where indicated.
- C. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AGM Industries, Inc.; TACTOO Adhesive.
 - b. Gemco; Tuff Bond Hanger Adhesive.

2.8 SPRAY-APPLIED CELLULOSIC INSULATION

- A. Insulation shall comply 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. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 percent.

2.9 REFLECTIVE INSULATIONS

- A. Insulation shall comply 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".

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation or vapor retarders, including removing projections capable of puncturing 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 indicated.

- 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. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.3 INSTALLATION OF BELOW-GRADE INSULATION

- A. On vertical footing and foundation wall surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
 - 1. If not otherwise indicated, extend insulation a minimum of 24 inches below exterior grade line. See construction documents.
- B. On horizontal surfaces under slabs, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
 - 1. If not otherwise indicated, extend insulation a minimum of 36 inches in from exterior walls. See construction documents.

3.4 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Foam-Plastic Board Insulation: Seal joints between units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

- C. Glass-Fiber or Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 4. Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
 5. For wood-framed construction, install blankets according to ASTM C 1320 and as follows:
 - a. With faced blankets having stapling flanges, secure insulation by inset, stapling flanges to sides of framing members.
 - b. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.
- D. Loose-Fill Insulation:
1. Install in accordance with manufacturer's instructions
 2. Install in exterior spaces without gaps or voids. Do not compress insulation.
 3. Trim insulation tight in spaces. Insulate miscellaneous gaps and voids.
 4. Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services with plane of insulation.
 5. Install insulation with vapor barrier installed facing warm side. Seal or tape joints as required.
- E. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation.

3.5 INSTALLATION OF INSULATION IN CEILINGS FOR SOUND ATTENUATION

- A. Where glass-fiber blankets are indicated for sound attenuation above ceilings, install blanket insulation over entire ceiling area in thicknesses indicated. Extend insulation 48 inches up either side of partitions.

3.6 INSTALLATION OF INSULATION FOR CONCRETE SUBSTRATES

- A. Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:
 - 1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.
 - 2. Apply insulation standoffs to each spindle to create cavity width indicated between concrete substrate and insulation.
 - 3. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation below indicated thickness.
 - 4. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

3.7 INSTALLATION OF VAPOR RETARDERS

- A. Place vapor retarders on side of construction indicated on Drawings. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives or other anchorage system as indicated. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.
- B. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs.
 - 1. Fasten vapor retarders to wood framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints. Space fasteners 16 inches o.c.
 - 2. Before installing vapor retarders, apply urethane sealant to flanges of metal framing including runner tracks, metal studs, and framing around door and window openings. Seal overlapping joints in vapor retarders with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Seal butt joints with vapor-retarder tape. Locate all joints over framing members or other solid substrates.
 - 3. Firmly attach vapor retarders to metal framing and solid substrates with vapor-retarder fasteners as recommended by vapor-retarder manufacturer.

- C. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.
- D. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

3.8 PROTECTION

- A. Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

3.9 INSULATION SCHEDULE

- A. The following values in the Schedule are "Performance" based. The values meet the requirements of ASHRAE/IESNA Standard 90.1 achieved through Latest Version of "COMcheck". The "Performance" values are based on the IECC 2015, International Energy Conservation Code requirements for a **Climate Zone 5B** which is compliant for most counties of state of Utah. If the Project is located in Box Elder, Cache, Carbon, Daggett, Duchesne, Rich, Summit, Uintah and Wasatch the Climate Zone is 6B and 'R'-values may/may not increase and are found in the IECC. Washington county is a Climate Zone 3B and 'R'- values may/may not decrease and are found in the IECC. (See Insulation Schedule on sheet G-002 if a discrepancy exists between this schedule and the one below the one on G-002 should govern).

LOCATION	TYPE	THICKNESS	"R" VALUE	REMARKS (Basis-of-Design)
PERIMETER BELOW SLAB INSULATION	RIGID	2"	R-10	OWENS CORNING-FOAMULAR 250
PERIMETER FOUNDATION WALL	RIGID	2"	R-10	OWENS CORNING- FOAMULAR 250

WALL INSULATION: EXTERIOR FRAMED	RIGID, CONT. BATT	1" 5 1/2"	R-5 R-21 Total: R-38	-OWENS CORNING FOAMULAR 250 -CERTINTEED CERTA PRO ACOUSTI THERM UNFACED FRICTION BATTS OR OWENS CORNING THERMAL BATT
ROOFING: (ABOVE SUBSTRATE)	BATT	14"	R-49	OWENS COORNING – THERMAL BATT
INTERIOR WALLS OF SPACES UNLESS MODIFIED BELOW	NON REQUIRED	-	-	-
BATHROOMS AND SLEEPING ROOMS	SOUND BATT	MATCH PER WALL CAVITY	MATCH PER WALL CAVITY	SOUND/ THERMAL

END OF SECTION 07 2100

SECTION 07 2500 - WEATHER BARRIERS

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. Building wrap:
 - a. For building wrap behind CMU veneer and siding.
- 2. Flexible flashing.

- B. Related Requirements:

- 1. Division 06 Section "Sheathing" for substrate.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. For building wrap, include data on air and water-vapor permeance based on testing according to referenced standards.

1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For water-resistive barrier and flexible flashing, from ICC-ES.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Basis-of-Design Product: The design is based on the product named in the basis-of-design and within the Construction Drawings. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified and based on substitution request approval.

- B. See Div 01 Section 01 2500 for "Substitution Procedures".

2.2 WATER-RESISTIVE BARRIER

A. Building Wrap for all location except behind stucco:

1. Basis-of-Design Product: A 7.1 mils of spunbonded polyolefin, non-woven weather barrier by Dupont™ the product Tyvek® CommercialWrap® and related assembly components.
 - a. Dupont; 4417 Lancaster Pike, Chestnut Run Plaza 728, Wilmington, DE 19805; 1-800-44-TYVEK (8-9835); <http://www.construction.tyvek.com>
 - b. Performance Characteristics:
 - 1) Air Penetration: 0.001 cfm/ft² at 75 Pa, when tested in accordance with ASTM E2178. Type I per ASTM E1677. ≤0.04 cfm/ft² at 75 Pa, when tested in accordance with ASTM E2357.
 - 2) Water Vapor Transmission: 28 perms, when tested in accordance with ASTM E96, Method B.
 - 3) Water Penetration Resistance: Minimum 280 cm when tested in accordance with AATCC Test Method 127.
 - 4) Basis Weight: Minimum 2.7 oz/yd², when tested in accordance with TAPPI Test Method T-410.
 - 5) Air Resistance: Air infiltration at >1500 seconds, when tested in accordance with TAPPI Test Method T-460.
 - 6) Tensile Strength: Minimum 38/35 lbs/in., when tested in accordance with ASTM D882, Method A.
 - 7) Tear Resistance: 12/10 lbs., when tested in accordance with ASTM D1117.
 - 8) Surface Burning Characteristics: Class A, when tested in accordance with ASTM E84. Flame Spread: 10, Smoke Developed: 10.
2. Alternative Manufactures: Subject to compliance with requirements, available manufactures offering products that may be incorporated in the Work include, but are not limited to the following:
 - a. Benjamin Obdyke Inc.; "FlatWrap® HP Commercial-Grade WRB"; www.benjaminobdyke.com.
 - b. CertainTeed Corp.; "CertaWrap™"; www.certainteed.com.
 - c. Polymer Group, Inc.; "Typar MetroWrap"; www.typar.com.

B. Building Wrap at stucco locations:

1. Basis-of-Design Product: A textured, spunbonded polyolefin, non-woven weather barrier by Dupont™ the product Tyvek® StuccoWrap® and related assembly components.
 - a. Dupont; 4417 Lancaster Pike, Chestnut Run Plaza 728, Wilmington, DE 19805; 1-800-44-TYVEK (8-9835); <http://www.construction.tyvek.com>
 - b. Performance Characteristics:
 - 1) Air Penetration: 0.004 cfm/ft² at 75 Pa, when tested in accordance with ASTM E2178. Type I per ASTM E1677. ≤0.04 cfm/ft² at 75 Pa, when tested in accordance with ASTM E2357.

- 2) Water Vapor Transmission: 50 perms, when tested in accordance with ASTM E96, Method B.
 - 3) Water Penetration Resistance: Minimum 210 cm when tested in accordance with AATCC Test Method 127.
 - 4) Basis Weight: Minimum 2.1 oz/yd², when tested in accordance with TAPPI Test Method T-410.
 - 5) Air Resistance: Air infiltration at >300 seconds, when tested in accordance with TAPPI Test Method T-460.
 - 6) Tensile Strength: Minimum 30/30 lbs/in., when tested in accordance with ASTM D882, Method A.
 - 7) Tear Resistance: 7/9 lbs., when tested in accordance with ASTM D1117.
 - 8) Surface Burning Characteristics: Class A, when tested in accordance with ASTM E84. Flame Spread: 5, Smoke Developed: 25.
- C. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

2.3 MISCELLANEOUS MATERIALS

- A. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt 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.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Benjamin Obdyke HydroFlash®.
 - b. Dupont (E. I. du Pont de Nemours and Company); DuPont Flashing Tape.
 - c. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Vycor Butyl Self Adhered Flashing.
 - d. Protecto Wrap Company; BT-25 XL.
 - e. Raven Industries Inc.; Fortress Flashshield.
 - f. Sandell Manufacturing Co., Inc.; Presto-Seal.
- B. Primer for Flexible Flashing: Product recommended by manufacturer of flexible flashing for substrate.
- C. Nails and Staples: ASTM F 1667.

PART 3 - EXECUTION

3.1 WATER-RESISTIVE BARRIER INSTALLATION

- A. Cover exposed exterior surface of sheathing with water-resistive barrier securely fastened to framing immediately after sheathing is installed.
- B. Cover sheathing with water-resistive barrier as follows:

1. Cut back barrier 1/2 inch on each side of the break in supporting members at expansion- or control-joint locations.
 2. Apply barrier to cover vertical flashing with a minimum 4-inch overlap unless otherwise indicated.
- C. Building Wrap: Comply with manufacturer's written instructions.
1. Seal seams, edges, fasteners, and penetrations with tape.
 2. Extend into jambs of openings and seal corners with tape.

3.2 FLEXIBLE FLASHING INSTALLATION

- A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.
1. Prime substrates as recommended by flashing manufacturer.
 2. Lap seams and junctures with other materials at least 4 inches except that at flashing flanges of other construction, laps need not exceed flange width.
 3. Lap flashing over water-resistive barrier at bottom and sides of openings.
 4. Lap water-resistive barrier over flashing at heads of openings.
 5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

END OF SECTION 07 2500

SECTION 074113.13 – STANDING-SEAM METAL ROOF PANELS

PART 1 GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To
 - 1. Furnish and install metal roofing system as described in Contract Documents

1.2 SYSTEM DESCRIPTION

- A. Performance Requirements - Roof construction shall carry UL Construction Uplift Rating of at least Class 90.

1.3 SUBMITTALS

- A. Product Data - Manufacturer's literature.
- B. Shop Drawings - Show all aspects of installation and accessories.

1.5 WARRANTY

- A. 20 year minimum guarantee on weather tightness and finish of roof system.
- B. Manufacturer's written 20 year guarantee for steel finishes.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Basis-of-Design Approved Manufacture: American Building Components; www.abcmetalroofing.com.
- B. Equal approved by architect before bidding.

2.2 PRODUCTS

- A. Basis-of-Design Roofing Panels:
 - 1. ABC Model No. SL-16 Standing Seam Roof Panel.
 - 2. Finish- Finish shall be '**Signature 300**' coating system based on 70% KYNAR 5000 PVDF fluoropolymer resin.
 - 3. Panel:
 - a. Panels shall have 1" high vertical legs, spaced 16" on center and shall have no exposed fasteners.

- b. Concealed fastener metal panel.
 - c. Gauge: 26.
 - d. Color: Architect selected from manufacturers full range of colors.
 - e. Certification shall be submitted, based on independent testing laboratory, indicating no measurable water penetration or air leakage through the system when tested in accordance with ASTM E-1680 and E-1646.
- B. Accessories
- 1. Provide all accessories and fasteners recommended by manufacturer for proper installation.
 - 2. Provide all closure trims and flashing as indicated on the drawings.
 - 3. Fasteners with neoprene gaskets.
 - 4. Neoprene closure.
 - 5. Vented Ridge, Low-profile. Color to match metal roof finish.
 - 6. Vented wall high side eave trim. Color to match metal roof finish.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install roofing, valleys, and coping as shown in Manufacturer's details and specifications.

END OF SECTION 074113.13

SECTION 07 4213.53 - METAL SOFFIT PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes metal soffit panels.
- B. Related Sections:
 - 1. Section 07 4213.19 "Insulated Metal Wall Panels" for lap-seam metal wall panels.
 - 2. Section 07 6200 "Sheet Metal Flashing and Trim" for metal flashing not covered in this Section.
 - 3. Section 07 7200 "Roof Accessories" for roof venting.

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 for each type of panel and accessory.
- B. Shop Drawings:
 - 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
 - 2. Accessories: Include details of flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.
- C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.
 - 1. Include similar Samples of trim and accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
 - 1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, tests performed by a qualified testing agency.
- C. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panels to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical roof eave, including fascia, and soffit as shown on Drawings; approximately four panels wide by full eave width, including attachments and accessories.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

- E. Copper Panels: Wear gloves when handling to prevent fingerprints and soiling of surface.

1.8 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.9 COORDINATION

- A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

- 1. Failures include, but are not limited to, the following:

- a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.

- 2. Warranty Period: Two years from date of Substantial Completion.

- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

- 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

- a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

- 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Basis-of-Design Product: The design is based on the product named in the basis-of-design and within the Construction Drawings. Subject to compliance with requirements,

provide either the named product or a comparable product by one of the other manufacturers specified and based on substitution request approval.

- B. See Div 01 Section 01 2500 for "Substitution Procedures".

2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
 - 3. Deflection Limits: For wind loads, no greater than 1/180 of the span.
- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 283 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 1.57 lbf/sq. ft..
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 6.24 lbf/sq. ft..
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 180 deg F, material surfaces.

2.3 METAL SOFFIT PANELS

- A. General: Provide metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.
- B. V-Groove-Profile Metal Soffit Panels: Perforated panels formed with vertical panel edges and intermediate stiffening ribs symmetrically spaced between panel edges; with a V-groove joint between panels.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide American Building Products: LG-142 V-groove comparable product by one of the following:
 - a. Berridge Manufacturing Company.
 - b. Fabral.
 - c. CENTRIA Architectural Systems.

2. Basis-of-Design Product Characteristics:

- a. Panel Attachment: Hidden fastening system.
- b. Gauge: 29.
- c. Finishes: Smooth.
- d. Coatings: Galvalume plus signature 200. Color as selected by Owner/Architect from standard colors.

2.4 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
 1. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
 2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.5 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

- B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
 - 3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 - 4. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal soffit panel manufacturer for application but not less than thickness of metal being secured.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
 - 1. Examine framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal panel manufacturer.
 - 2. Examine sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal panel manufacturer.
 - a. Verify that air- or water-resistive barriers been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 METAL PANEL INSTALLATION

- A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Shim or otherwise plumb substrates receiving metal panels.
 - 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
 - 3. Install screw fasteners in predrilled holes.
 - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 5. Install flashing and trim as metal panel work proceeds.
 - 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 - 7. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
 - 1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
 - 1. Apply panels and associated items true to line for neat and weathertight enclosure.
 - 2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
 - 3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
 - 4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
- E. Watertight Installation:
 - 1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels and elsewhere as needed to make panels watertight.

2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
 3. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.
- F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal panel system including trim, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.
- G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
1. Install exposed flashing and trim that is without buckling, and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to achieve waterproof performance.
 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- 3.4 CLEANING AND PROTECTION
- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
 - B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
 - C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 4213.53

SECTION 07 6200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: (Aluminum and/or galvanized steel)
 - 1. Manufactured Reglets.
 - 2. Formed roof drainage sheet metal fabrications.
 - 3. Formed wall sheet metal fabrications.
- B. Related Sections:
 - 1. Division 06 Section "Rough Carpentry" and "Sheathing" for backing and support material for fabrications.
 - 2. Division 07 Section "Metal/Composite Wall Panels".

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
 - 1. Include details for forming, joining, supporting, and securing sheet metal flashing and trim, including pattern of seams, termination points, fixed points, expansion joints, expansion-joint covers, edge conditions, special conditions, and connections to adjoining work.
- C. Samples: For each exposed product and for each finish specified.
- D. Maintenance data.
- E. Warranty: Sample of special warranty.

1.3 QUALITY ASSURANCE

- A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.
- B. Preinstallation Conference: Conduct conference at Project site.

1.4 WARRANTY

- A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.
- B. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required.
 - 1. As-Milled Finish: One-side bright mill finish.
 - 2. Factory Prime Coating: Where painting after installation is indicated, pretreat with white or light-colored, factory-applied, baked-on epoxy primer coat; minimum dry film thickness of 0.2 mil.
 - 3. Clear Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
 - 4. Exposed Coil-Coated Finishes:
 - a. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat.
 - 5. Color: As selected by Architect from manufacturer's full range.
- C. Metallic-Coated Steel Sheet: Restricted flatness steel sheet, metallic coated by the hot-dip process and pre-painted by the coil-coating process to comply with ASTM A 755/A 755M.
 - 1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation; structural quality.
 - 2. Surface: Manufacturer's standard clear acrylic coating on both sides.
 - 3. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat.
 - 4. Color: As selected by Architect from manufacturer's full range.

2.2 UNDERLAYMENT MATERIALS

- A. Polyethylene Sheet: 6-mil-thick polyethylene sheet complying with ASTM D 4397.
- B. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

- C. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
 - 1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F.
 - 2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F.
- D. Slip Sheet: Building paper, 3-lb/100 sq. ft. minimum, rosin sized.

2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item 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 or manufactured item.
 - 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.
 - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
 - 2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
 - 3. Fasteners for zinc-coated (galvanized) steel sheet: Hot-dip galvanized steel according to ASTM A 153/A 153m or ASTM F 2329 or series 300 stainless steel.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, gray 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 C 920, elastomeric polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- G. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.4 REGLETS

- A. Reglets: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated.
 - 1. Material: Aluminum, 0.024 inch thick, galvanized steel, 0.022 inch thick.
 - 2. Finish: Mill with manufacturer's standard color coating.

2.5 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.
 - 1. Obtain field measurements for accurate fit before shop fabrication.
 - 2. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
 - 3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.
- B. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.
- C. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
- D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- E. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- F. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

2.6 ROOF DRAINAGE SHEET METAL FABRICATIONS

- A. Hanging Gutters: Fabricate to cross section indicated, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch-long sections. Furnish flat-stock gutter spacers and gutter brackets fabricated from same metal as gutters, of size recommended by SMACNA but not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters.
- B. Downspouts: Fabricate rectangular downspouts complete with mitered elbows. Furnish with metal hangers, from same material as downspouts, and anchors.

1. Hanger Style:
2. Fabricate from the following materials:
 - a. Galvanized Steel: 0.022 inch thick.

2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof-Edge Flashing: Fabricate in minimum 96-inch-long, but not exceeding 10-foot-long, sections. Furnish with 6-inch-wide, joint cover plates. Fabricate from the following materials:
 1. Galvanized Steel: 0.019 inch thick.
- B. Copings: Fabricate in minimum 96-inch-long, but not exceeding 10-foot-long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and interior leg. Miter corners, seal, and solder or weld watertight. Fabricate from the following materials:
 1. Galvanized Steel: 0.019 inch thick.
- C. Base Flashing: Fabricate from the following materials:
 1. Galvanized Steel: 0.019 inch thick.
- D. Counterflashing and Flashing Receivers: Fabricate from the following materials:
 1. Galvanized Steel: 0.022 inch thick.
- E. Roof-Penetration Flashing: Fabricate from the following materials:
 1. Galvanized Steel: 0.028 inch thick.

2.8 WALL SHEET METAL FABRICATIONS

- A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch-long, but not exceeding 12-foot-long, sections, under copings, at shelf angles, and where indicated. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings. Form with 2-inch-high, end dams where flashing is discontinuous. Fabricate from the following materials:
 1. Galvanized Steel: 0.019 inch thick.
- B. Wall Expansion-Joint Cover: Fabricate from the following materials:
 1. Galvanized Steel: 0.019 inch thick.

PART 3 - EXECUTION

3.1 UNDERLAYMENT INSTALLATION

- A. Polyethylene Sheet: Install polyethylene sheet with adhesive for anchorage. Apply in shingle fashion to shed water, with lapped and taped joints of not less than 2 inches.
- B. Felt Underlayment: Install felt underlayment with adhesive for temporary anchorage. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.
- C. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.

3.2 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement so that completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 - 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 - 3. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
 - 4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
 - 5. Install sealant tape where indicated.
 - 6. Torch cutting of sheet metal flashing and trim is not permitted.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.
 - 1. Coat back side of uncoated aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
 - 2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches

of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.

- D. Fastener Sizes: Use fasteners of sizes that will penetrate wood sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
- E. Seal joints as shown and as required for watertight construction.
- F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches, except reduce pre-tinning where pre-tinned surface would show in completed Work.
 - 1. Do not solder metallic-coated steel and aluminum sheet.
 - 2. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
- G. Rivets: Rivet joints in uncoated aluminum where indicated and where necessary for strength.

3.3 ROOF DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.
- B. Hanging Gutters: Join sections with riveted and soldered joints or with lapped joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchored gutter brackets spaced not more than 36 inches apart. Provide end closures and seal watertight with sealant. Slope to downspouts.
 - 1. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet apart. Install expansion-joint caps.
 - 2. Install continuous gutter screens on gutters with removable covers for cleaning gutters.
- C. Built-in Gutters: Join sections with riveted and soldered or lapped joints sealed with sealant. Provide for thermal expansion. Slope to downspouts. Provide end closures and seal watertight with sealant.
 - 1. Install felt underlayment layer in built-in gutter trough and extend to drip edge at eaves and under felt underlayment on roof sheathing. Lap sides a minimum of 2 inches over underlying course. Lap ends a minimum of 4 inches. Stagger end laps between succeeding courses at least 72 inches. Fasten with roofing nails. Install slip sheet over felt underlayment.
 - 2. Install gutter with expansion joints at locations indicated, but not exceeding, [50 feet] <Insert dimension> apart. Install expansion-joint caps.
- D. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches o.c. in between.

- E. Splash Pans: Install where downspouts discharge on low-slope roofs. Set in adhesive material compatible with the roofing.
- F. Parapet Scuppers: Install scuppers where indicated through parapet. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
- G. Conductor Heads: Anchor securely to wall with elevation of conductor head rim 1 inch below scupper and/or gutter discharge.
- H. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated. Lap joints a minimum of 4 inches in direction of water flow.

3.4 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.
- C. Copings: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated.
 - 1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 16-inch centers.
 - 2. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch centers.
- D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.
- E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with sealant.
- F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with sealant compatible and recommended by Roofing Manufacturer.

3.5 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of

wall flashing with installation of wall-opening components such as windows, doors, and louvers.

- B. Through-Wall Flashing: Installation of through-wall flashing is specified in Division 04 Section "Unit Masonry."
- C. Reglets: Installation of reglets is specified in Division 03 Section "Cast-in-Place Concrete Division 04 Section "Unit Masonry."
- D. Opening Flashings in Frame Construction: Install continuous head, sill, and similar flashings to extend 4 inches beyond wall openings.

3.6 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder and sealants.
- C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

END OF SECTION 07 6200

SECTION 07 7200 - ROOF 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. Roof curbs.
2. Equipment supports.
3. Roof hatches.
4. Roof Ventilator.

- B. Related Sections:

1. Division 05 Section "Metal Fabrications" for metal vertical ladders, ships' ladders, and stairs for access to roof hatches.
2. Division 05 Section "Pipe and Tube Railings" for safety railing systems not attached to roof-hatch curbs.
3. Division 07 Section "Metal Soffit Panels" for soffit venting.
4. Division 07 Section "Sheet Metal Flashing and Trim" for shop- and field-formed metal flashing, roof-drainage systems, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.

1.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.

1.5 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

1.7 COORDINATION

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
- B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.8 WARRANTY

- A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 METAL MATERIALS

- A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation and mill phosphatized for field painting where indicated.
 - 1. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.
 - 2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.
- B. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, AZ50 coated.

1. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.
 2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.
- C. Aluminum Sheet: ASTM B 209, manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.
1. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.
- D. Aluminum Extrusions and Tubes: ASTM B 221, manufacturer's standard alloy and temper for type of use, finished to match assembly where used, otherwise mill finished.
- E. Copper Sheet: ASTM B 370, manufacturer's standard temper.
- F. Stainless-Steel Sheet and Shapes: ASTM A 240/A 240M or ASTM A 666, Type 304.
- G. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized according to ASTM A 123/A 123M unless otherwise indicated.
- H. Steel Tube: ASTM A 500, round tube.
- I. Galvanized-Steel Tube: ASTM A 500, round tube, hot-dip galvanized according to ASTM A 123/A 123M.
- J. Steel Pipe: ASTM A 53/A 53M, galvanized.
- 2.2 MISCELLANEOUS MATERIALS
- A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than 1-1/2 inches thick.
- C. Underlayment:
1. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
 2. Polyethylene Sheet: 6-mil-thick polyethylene sheet complying with ASTM D 4397.
 3. Slip Sheet: Building paper, 3-lb/100 sq. ft. minimum, rosin sized.

- D. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
 - 1. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.
 - 2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
- E. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.
- F. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

2.3 ROOF CURBS

- A. Roof Curbs: Internally reinforced roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings; with welded or mechanically fastened and sealed corner joints, integral metal cant, and integrally formed deck-mounting flange at perimeter bottom.
 - 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. AES Industries, Inc.
 - b. Curbs Plus, Inc.
 - c. Custom Solution Roof and Metal Products.
 - d. Greenheck Fan Corporation.
 - e. LM Curbs.
 - f. Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.
 - g. Pate Company (The).
 - h. Roof Products, Inc.
 - i. Thybar Corporation.
 - j. Vent Products Co., Inc.
- B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.
- C. Material: Zinc-coated (galvanized) steel sheet, 0.052 inch thick.
 - 1. Finish: Baked enamel or powder coat.
 - 2. Color: As selected by Architect from manufacturer's full range.
- D. Material: Aluminum sheet, 0.090 inch thick.
 - 1. Finish: Baked enamel or powder coat.
 - 2. Color: As selected by Architect from manufacturer's full range.

E. Construction:

1. Insulation: Factory insulated with 1-1/2-inch-thick cellulosic-fiber board insulation.
2. Liner: Same material as curb, of manufacturer's standard thickness and finish.
3. Factory-installed wood nailer at top of curb, continuous around curb perimeter.
4. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
5. Fabricate curbs to minimum height of 12 inches unless otherwise indicated.
6. Top Surface: Level around perimeter with roof slope accommodated by sloping the deck-mounting flange.
7. Sloping Roofs: Where roof slope exceeds 1:48, fabricate curb with perimeter curb height tapered to accommodate roof slope so that top surface of perimeter curb is level. Equip unit with water diverter or cricket on side that obstructs water flow.
8. Security Grille: Provide where indicated.

2.4 EQUIPMENT SUPPORTS

A. Equipment Supports: Internally reinforced metal equipment supports capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings; with welded or mechanically fastened and sealed corner joints, integral metal cant, and integrally formed deck-mounting flange at perimeter bottom.

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. AES Industries, Inc.
 - b. Curbs Plus, Inc.
 - c. Custom Solution Roof and Metal Products.
 - d. Greenheck Fan Corporation.
 - e. LM Curbs.
 - f. Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.
 - g. Pate Company (The).
 - h. Roof Products, Inc.
 - i. Thybar Corporation.
 - j. Vent Products Co., Inc.

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

C. Material: Zinc-coated (galvanized) steel sheet, 0.052 inch thick.

1. Finish: Baked enamel or powder coat.
2. Color: As selected by Architect from manufacturer's full range.

D. Material: Aluminum sheet, 0.090 inch thick.

1. Finish: Baked enamel or powder coat.
2. Color: As selected by Architect from manufacturer's full range.

E. Construction:

1. Insulation: Factory insulated with 1-1/2-inch-thick cellulosic-fiber board insulation.
2. Liner: Same material as equipment support, of manufacturer's standard thickness and finish.
3. Factory-installed continuous wood nailers 3-1/2 inches wide at tops of equipment supports.
4. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as equipment support.
5. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
6. Fabricate equipment supports to minimum height of 12 inches unless otherwise indicated.
7. Sloping Roofs: Where roof slope exceeds 1:48, fabricate each support with height to accommodate roof slope so that tops of supports are level with each other. Equip supports with water diverters or crickets on sides that obstruct water flow.
8. Security Grille: Provide where indicated.

2.5 PASSIVE EXHAUST VENTILATOR

A. Ventilators:

1. Basis-of-Design Product: Subject to compliance with requirements provide Active Ventilation Products Inc.; Aura Roof Vent; Model No- AV-8-C8 & AV-12-C8 and accessories for a complete installation of ventilators
2. Provide integral weathertight base cap, outlet duct, and rotating louvered turbine.
3. Throat Size and Height: 8" or 12" diameter throat size with a collar height of 8". Consult each build type's roof plan for location of each ventilator and for each size.
4. Insect Screens: Manufacturer's standard mesh with rewireable frame.
5. Weathertight Base Cap, Outlet Duct, and Turbine Material: Aluminum sheet, of manufacturer's standard thickness.
6. Finish: Mill Finish.

2.6 PREFORMED FLASHING SLEEVES

A. Exhaust Vent Flashing: Double-walled metal flashing sleeve or boot, insulation filled, with integral deck flange, 12 inches high, with removable metal hood and slotted metal collar.

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. Custom Solution Roof and Metal Products.
 - b. Thaler Metal USA Inc.
2. Metal: Aluminum sheet, 0.063 inch thick.
3. Diameter: As indicated.

4. Finish: Manufacturer's standard.
- B. Vent Stack Flashing: Metal flashing sleeve, uninsulated, with integral deck flange.
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. Custom Solution Roof and Metal Products.
 - b. Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.
 - c. Thaler Metal USA Inc.
 2. Metal: Aluminum sheet, 0.063 inch thick.
 3. Height: 13 inches.
 4. Diameter: As indicated.
 5. Finish: Manufacturer's standard.

2.7 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- C. Verify dimensions of roof openings for roof accessories.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install roof accessories according to manufacturer's written instructions.
1. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.
 2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.

3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
 4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
1. Coat concealed side of uncoated aluminum or stainless-steel roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene sheet.
 3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.
- C. Roof Curb Installation: Install each roof curb so top surface is level.
- D. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.
- E. Roof-Hatch Installation:
1. Install roof hatch so top surface of hatch curb is level.
 2. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
 3. Attach safety railing system to roof-hatch curb.
 4. Attach ladder-assist post according to manufacturer's written instructions.
- F. Ventilator Installation:
1. Locate ventilators as indicated on Drawings. Ensure openings do not conflict with roof framing members. Accurately cut opening in roof substrate using template and pilot hole.
 2. Roof mounting flange installation on single ply membrane roofing system:
 - a. Install roof mounting flange as part of single ply membrane roofing. If head is removed, provide temporary cap for flange opening.
 - b. Trim corners of mounting flange to provide smooth radius without sharp points.
 - c. Apply butyl tape sealant or roofing mastic to bottom of roof mounting flange. Set mounting flange over roof opening into single ply roof membrane.
 - d. Securely anchor flange to roof substrate with fasteners of type, size, and spacing recommended by manufacturer.
 - e. Install piece of single ply roofing over mounting flange. Secure with adhesive, heat welding, or other procedure as part of roofing operation.

3. After roof system installation is complete, remove temporary cap if head was removed and install ventilator collar onto mounting flange. Attach with fasteners and apply sealant to collar and flange joint.
 4. Test dampers and adjust for proper operation.
- G. Pipe Support Installation: Install pipe supports so top surfaces are in contact with and provide equally distributed support along length of supported item.
- H. Preformed Flashing-Sleeve Installation: Secure flashing sleeve to roof membrane according to flashing-sleeve manufacturer's written instructions.
- I. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

3.3 REPAIR AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780.
- B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Division 09 painting Sections.
- C. Clean exposed surfaces according to manufacturer's written instructions.
- D. Clean off excess sealants.
- E. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07 7200

SECTION 07 7253 - SNOW FENCE

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. Cross member, standing seam-mounted snow fence.

- B. Related Requirements:

- 1. Section 07 4113.16 "Standing-Seam Metal Roof Panels" for seam attachment and manufacturer's requirement.

1.3 ACTION SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for snow fence.

- B. Shop Drawings: Include roof plans showing layouts and attachment details of snow guards.

- 1. Include calculation of number and location of snow fence based on snow load, roof slope, roof type, components, spacing, and finish.

- C. Samples: Full-size unit.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of snow fence, for tests performed by manufacturer and witnessed by a qualified testing agency.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Basis-of-Design Product: The design is based on the product named in the basis-of-design and within the Construction Drawings. Subject to compliance with requirements,

provide either the named product or a comparable product by one of the other manufacturers specified and based on substitution request approval.

- B. See Division 01 Section 01 2500 for "Substitution Procedures".

2.2 PERFORMANCE REQUIREMENTS

- A. Performance Requirements: Provide snow guards that withstand exposure to weather and resist thermally induced movement without failure, rattling, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

- 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

- B. Structural Performance:

- 1. Snow Loads: As indicated on Drawings.

2.3 CROSS BAR - TYPE SNOW GUARDS

- A. Seam-Mounted Metal Snow fence:

- 1. Manufacturers: Subject to compliance with requirements, provide products by but, not limited by one of the following:

- a. Alpinesnowguards.com, model ASG3000G 2 pipe rail system mounted to standing seam roof seams with compatible clip system.
 - b. Rockymountainsnowguards.com, model S-5! Blizzard II 2 pipe rail system mounted to standing seam roof seams with compatible clip system.
 - c. Snoshield.com, model S-5! DualGuard 2 pipe rail system mounted to standing seam roof seams with compatible clip system.
 - d. Trasnowardsun.com, model C22Z clamp-on 2 pipe rail system mounted to standing seam roof seams with compatible clip system.

- 2. Prior to purchase and installation snow fence confirm that snow fence and metal roof panel standing seam style is compatible with the snow fence manufacturers clip system and that the metal roof manufacturer warranty is not voided by snow fence method or system of attachment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, snow guard attachment, and other conditions affecting performance of the Work.

- 1. Verify compatibility with and suitability of substrates including compatibility with existing finishes or primers.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean and prepare substrates for bonding snow fence.
- B. Prime substrates according to snow guard manufacturer's written instructions.

3.3 INSTALLATION

- A. Install snow guards according to manufacturer's written instructions. Reference construction document set for location of snow fence.
- B. Attachment for Standing-Seam Metal Roofing:
 - 1. Do not use fasteners that will penetrate metal roofing or, fastening methods that void metal roofing finish warranty.
 - 2. Seam-Mounted Metal Snow fence clips: Stainless-steel clamps attached to vertical ribs of standing-seam metal roof panels.

END OF SECTION 07 7253

SECTION 07 8413 - 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 for the passage of duct, cable, cable tray, conduit, piping, electrical busways and raceways through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.
2. Blank openings through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.
3. Openings and penetrations in fire-rated partitions or walls containing fire doors.
4. Openings around structural members which penetrate floors or walls.

B. Related Requirements:

1. Section 07 8100 "Applied Fireproofing" for fire-resistance of structural systems.
2. Section 07 8443 "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 REFERENCES

- A. Underwriters Laboratories, Inc. (UL) of Northbrook, IL publishes tested systems in their "Fire Resistance Directory" that is updated annually:

1. Firestop Devices (XHJI).
2. Fire Resistance Ratings (BXRH).
3. Through-Penetration Firestop Systems (XHEZ).
4. Fill, Voids or Cavity Material (XHHW).
5. Forming Materials (XHKU).

- B. Test Requirements: ASTM E 814, "Standard Method of Fire Tests of Through Penetration FireStops".

- C. Test Requirements: UL 1479, "Fire Tests of Through-Penetration Firestops".

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Submit safety data sheets provided with product delivered to job-site.
- B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.

1.6 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. Engineering Judgments: For those firestop applications that exist for which no tested and listed system is available through a manufacturer, an engineering judgment derived from similar tested system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment documents shall follow requirements set forth by the International Firestop Council.

1.7 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."
- B. Fire-Test-Response Characteristics: Provide through-penetration fire stop systems that comply with specified requirements of tested systems.
- C. Firestop System installation must meet requirements of ASTM E 814, UL 1479 or UL 2079 tested assemblies that provide a fire rating equal to that of construction being penetrated.
- D. Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.
- E. Firestop systems do not reestablish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.

- F. For those firestop applications that exist for which no qualified tested system is available through a manufacturer, an engineering judgment derived from similar qualified tested system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation . Engineering judgment documents must follow requirements set forth by the International Firestop Council.

1.9 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.

1.10 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 FIRESTOPPING – GENERAL

- A. Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.
- B. Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.
- C. Mold Resistance: Provide penetration firestopping with mold and mildew resistance rating of zero (0) as determined by ASTM G21.
- D. Firestopping Materials are either "cast-in-place" (integral with concrete placement) or "post installed." Provide cast-in-place firestop devices prior to concrete placement.

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 shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

1. Basis-of-Design Product: Subject to compliance with through penetration firestop systems (XHEZ) listed in Volume II of the UL Fire Resistance Directory, provide products from the manufacturer Hilti, Inc., www.us.hilti.com; or a comparable product by one of the following:
 - a. 3M Fire Protection Products.
 - b. A/D Fire Protection Systems Inc.
 - c. Construction Solutions.
 - d. NUCO Inc.
 - e. Passive Fire Protection Partners.
 - f. RectorSeal.
 - g. Specified Technologies, Inc.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 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 E 814 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. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg.
 1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at and no more than 50-cfm cumulative total for any 100 sq. ft. at both ambient and elevated temperatures.
- E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.
- F. 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 MATERIALS

- A. Use only firestop products that have been UL 1479, ASTM E 814 or UL 2079 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.
- B. Pre-formed firestop devices for use with noncombustible and combustible pipes (closed and open systems), conduit, and/or cable bundles penetrating concrete floors the following Basis-of-Design products are acceptable:
1. Hilti Cast-In Place Firestop Device (CP 680-P).
 - a. Add Aerator Adaptor when used in conjunction with aerator system.
 2. Hilti Cast-In Place Firestop Device (CP 680-M) for use with noncombustible penetrants.
 3. Hilti Tub Box Kit (CP 681) for use with tub installations.
 4. Hilti Firestop Speed Sleeve (CP 653) for use with cable penetrations.
 5. Hilti Firestop Drop-In Device (CFS-DID) for use with noncombustible and combustible penetrants.
 6. Hilti Firestop Block (CFS-BL).
 7. Hilti Closet Stub (CFS-CID CS).
- C. Sealants, caulking materials, or foams for use with non-combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT), the following products are acceptable:
1. Hilti Intumescent Firestop Sealant (FS-ONE MAX).
 2. Hilti Fire Foam (CP 620).
 3. Hilti Flexible Firestop Sealant (CP 606).
 4. Hilti Firestop Silicone Sealant Gun Grade (CFS-S SIL GG).
 5. Hilti Firestop Silicone Sealant Self Leveling (CFS-S SIL SL).
- D. Sealants or caulking materials for use with sheet metal ducts, the following products are acceptable:
1. Hilti Silicone Sealant Gun Grade (CFS-S SIL GG).
 2. Hilti Firestop Silicone Sealant Self Leveling (CFS-S SIL SL).
 3. Hilti Flexible Firestop Sealant (CP 606).
 4. Hilti Intumescent Firestop Sealant (FS-ONE MAX).
- E. Intumescent sealants, caulking materials for use with combustible items (penetrants consumed by high heat and flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe, the following products are acceptable:
1. Hilti Intumescent Firestop Sealant (FS-ONE MAX).
- F. Foams, intumescent sealants, or caulking materials for use with flexible cable or cable bundles, the following products are acceptable:
1. Hilti Intumescent Firestop Sealant (FS-ONE MAX).

2. Hilti Fire Foam (CP 620).
 3. Hilti Flexible Firestop Sealant (CP 606).
 4. Hilti Firestop Silicone Sealant Gun Grade (CFS-S SIL GG).
 5. Hilti Firestop Silicone Sealant Self Leveling (CFS-S SIL SL).
- G. Non-curing, re-penetrable intumescent putty or foam material for use with flexible cable or cable bundles, the following products are acceptable:
1. Hilti Firestop Putty Stick (CP 618).
 2. Hilti Firestop Plug (CFS-PL).
- H. Wall opening protective materials for use with U.L. listed metallic and specified nonmetallic outlet boxes, the following products are acceptable:
1. Hilti Firestop Putty Pad (CFS-P PA).
 2. Hilti Firestop Putty Pad (CP 617).
 3. Hilti Firestop Box Insert.
- I. Fire stop collar or wrap devices attached to assembly around combustible plastic pipe (closed and open piping systems), the following products are acceptable:
1. Hilti Firestop Collar (CP 643N).
 2. Hilti Firestop Collar (CP 644).
 3. Hilti Wrap Strips (CP 648-E/648-S).
- J. Material used for large openings and complete penetrations made to accommodate cable trays and bundles, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:
1. Hilti Firestop Block (CFS-BL).
 2. Hilti Composite Sheet (CFS-COS).
 3. Hilti Firestop Mortar (CP 637).
 4. Hilti Fire Foam (CP 620).
 5. Hilti Firestop Board (CP 675T).
- K. Non-curing, re-penetrable materials used for large size/complex penetrations made to accommodate cable trays and bundles, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:
1. Hilti Firestop Block (CFS-BL).
 2. Hilti Firestop Board (CP 675T).
- L. Re-penetrable, round cable management devices for use with new or existing cable bundles penetrating gypsum or masonry walls, the following products are acceptable:
1. Hilti Firestop Speed Sleeve (CP 653) with integrated smoke seal fabric membrane.
 2. Hilti Firestop Cable Collar (CFS-CC).
 3. Hilti Firestop Sleeve (CFS-SL SK).
 4. Hilti Retrofit Sleeve (CFS-SL RK) for use with existing cable bundles.
 5. Hilti Gangplate (CFS-SL GP) for use with multiple cable management devices.
 6. Hilti Gangplate Cap (CFS-SL GP CAP) for use at blank openings in gangplate for future penetrations.

- M. For blank openings made in fire-rated wall or floor assemblies, where future penetration of pipes, conduits or cables is expected, the following products are acceptable:
 - 1. Hilti Firestop Block (CFS-BL).
 - 2. Hilti Firestop Plug (CFS-PL).

- N. For single or cable bundles up to one inch diameter penetrating gypsum, masonry, concrete walls or wood floor assemblies the following product is acceptable:
 - 1. Hilti Firestop Cable Disc (CFS-D).

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. 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.

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.
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 2. Contractor's name, address, and phone number.
 3. Designation of applicable testing and inspecting agency.
 4. Date of installation.
 5. Manufacturer's name.
 6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.
- 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 SCHEDULE OF MOST COMMON THROUGH FIRESTOP SYSTEMS (BASIS-OF-DESIGN)

Schedule of firestop systems. Basis-of-Design: Hilti, Inc.

CONCRETE FLOORS			CONCRETE OR BLOCK WALLS		
TYPE OF PENETRANT	F-RATING (HR)	BASIS OF DESIGN UL SYSTEM	TYPE OF PENETRANT	F-RATING (HR)	BASIS OF DESIGN UL SYSTEM
CIRCULAR BLANK OPENINGS	1	F-A-0006, C-AJ-0055, C-AJ-0090	CIRCULAR BLANK OPENINGS	1	C-AJ-0055, C-AJ-0090
	2	F-A-0006, C-AJ-0055, C-AJ-0090		2	C-AJ-0055, C-AJ-0090
	3	F-A-0006, C-AJ-0055, C-AJ-0086		3	C-AJ-0055, C-AJ-0086
SINGLE METAL PIPES OR CONDUIT	1	C-AJ-1226, F-A-1028, F-A-1017	SINGLE METAL PIPES OR CONDUIT	1	C-AJ-1226, W-J-1067, W-J-1020
	2	C-AJ-1226, F-A-1028, F-A-1017		2	C-AJ-1226, W-J-1067, W-J-1020, W-J-1248
	3	C-AJ-1226, F-A-1017		3	C-AJ-1226, W-J-1041, W-J-1068
	4	C-BJ-1037, C-BJ-1034		4	C-BJ-1034, C-BJ-1037, W-J-1041, W-J-1042, W-J-1068
SINGLE NON-METALLIC PIPE OR CONDUIT (I.E. PVC, CPVC, ABS, FRP, ENT)	1	F-A-2053, F-A-2025, C-AJ-2109, C-AJ-2098, C-AJ-2271, C-AJ-2167,	SINGLE NON-METALLIC PIPE OR CONDUIT (I.E. PVC, CPVC, ABS, FRP, ENT)	1	C-AJ-2109, C-AJ-2098, C-AJ-2167, C-AJ-2371, C-AJ-2342
	2	C-AJ-2098, C-AJ-2271, C-AJ-2167, C-BJ-2021, C-AJ-2371, C-AJ-2342		2	C-AJ-2109, C-AJ-2098, C-AJ-2167, C-AJ-2371, C-AJ-2342
	3	F-A-2054, C-AJ-2109, C-AJ-2098, C-AJ-2371, C-AJ-2342		3	C-AJ-2109, C-AJ-2098, C-AJ-2371, C-AJ-2342
	4	C-BJ-2016, C-AJ-2017		4	W-J-2057, W-J-2091
SINGLE/CABLE BUNDLES	1	F-A-3007, C-AJ-3095, C-AJ-3180, C-AJ-3283	SINGLE/CABLE BUNDLES	1	W-J-3036, C-AJ-3095, C-AJ-3180, W-J-3060, W-J-3167
	2	F-A-3007, C-AJ-3095, C-AJ-3334, F-A-3060		2	W-J-3036, C-AJ-3095, C-AJ-3180, W-J-3060, W-J-3167, W-J-3189
	3	F-A-3007, C-AJ-3095, C-AJ-3285		3	C-AJ-3095, C-AJ-3180, W-J-3167
				4	W-J-3050
CABLE TRAY	1	C-AJ-4034, C-AJ-4035	CABLE TRAY	1	W-J-4027, C-AJ-4034, C-AJ-4035
	2	C-AJ-4034, C-AJ-4035		2	W-J-4027, C-AJ-4034, C-AJ-4035
	3	C-AJ-4034, C-AJ-4035		3	C-AJ-4034, C-AJ-4035
				4	W-J-8007
SINGLE INSULATED PIPES	1	F-A 5015, F-A 5017, C-AJ-5090, C-AJ-5091, C-AJ-5090, C-AJ-5048	SINGLE INSULATED PIPES	1	C-AJ-5090, C-AJ-5091, C-AJ-5061, W-J-5042
	2	F-A 5015, F-A 5017, C-AJ-5090, C-AJ-5091, C-AJ-5090		2	C-AJ-5090, C-AJ-5091, C-AJ-5061, W-J-5042
	3	F-A 5016, C-AJ-5090, F-A-5018		3	C-AJ-5090, C-AJ-5061
	4	C-BJ-5006		4	C-BJ-5006, W-J-5028
ELECTRICAL BUSWAY	1	C-AJ-6006, C-AJ-6017, F-A-6002, C-AJ-6036	ELECTRICAL BUSWAY	1	C-AJ-6006, C-AJ-6017, C-AJ-6036
	2	C-AJ-6006, C-AJ-6017, F-A-6042, C-AJ-6036		2	C-AJ-6006, C-AJ-6017, C-AJ-6036
	3	C-AJ-6006, C-AJ-6017		3	C-AJ-6006, C-AJ-6017
MECHANICAL	1	C-AJ-7046, C-AJ-7051, C-AJ-	MECHANICAL	1	C-AJ-7046, C-AJ-7051, W-J-

DUCTWORK WITHOUT DAMPERS NON-INSULATED		7084	DUCTWORK WITHOUT DAMPERS NON-INSULATED		7021, W-J-7022
	2	C-AJ-7046, C-AJ-7051, C-AJ-7085		2	C-AJ-7046, C-AJ-7051, W-J-7021, W-J-7022
	3	C-AJ-7046, C-AJ-7051		3	C-AJ-7046, C-AJ-7051
MECHANICAL DUCTWORK WITHOUT DAMPERS INSULATED	N/A**	N/A**	MECHANICAL DUCTWORK WITHOUT DAMPERS INSULATED	1	W-J-7029, W-J-7124
				2	W-J-7091, W-J-7112, W-J-7124
MIXED PENETRANTS	1	C-AJ 8099, C-AJ-8056, C-AJ-8143	MIXED PENETRANTS	1	C-AJ 8099, C-AJ 8056, W-J 8007, C-AJ 8143
	2	C-AJ-8099, C-AJ-8056, C-AJ-8143		2	C-AJ 8099, C-AJ 8056, W-J 8007, C-AJ 8143
	3	C-AJ-8099, C-AJ-8056		3	C-AJ 8041, C-AJ 8056, W-J 8007, C-AJ 8099
	4	C-AJ-8095		4	C-AJ 8095, W-J 8007
WOOD FLOORS			GYPSUM WALLS		
TYPE OF PENETRANT	F-RATING (HR)	BASIS OF DESIGN UL SYSTEM	TYPE OF PENETRANT	F-RATING (HR)	BASIS OF DESIGN UL SYSTEM
METAL PIPES OR CONDUIT	1	F-C-1009, F-C-1059, F-C-1168	METAL PIPES OR CONDUIT	1	W-L-1054, W-L-1058, W-L-1164, W-L-1506
	2	F-C-1009, F-C-1059, F-C-1168		2	W-L-1054, W-L-1058, W-L-1164, W-L-1506
				4	W-L-1110, W-L-1111, W-L-1165
NON-METALLIC PIPE OR CONDUIT	1	F-C-2232, F-C-2030, F-C-2160, F-C-2389	NON-METALLIC PIPE OR CONDUIT	1	W-L-2078, W-L-2075, W-L-2128
	2	F-C-2029, F-C-2030, F-C-2128, F-C-2160		2	W-L-2078, W-L-2075, W-L-2128
				4	W-L-2184, W-L-2245
SINGLE OR BUNDLED CABLES	1	F-C-3012, F-C-3110, F-C-3044	SINGLE OR BUNDLED CABLES	1	W-L-3065, W-L-3111, W-L-3112, W-L-3334, W-L-3414, W-L-3396
	2	F-C-3012, F-C-3110		2	W-L-3065, W-L-3111, W-L-3112, W-L-3334, W-L-3414, W-L-3396
				3	W-L-3385, W-L-3277
				4	W-L-3139, W-L-3334
INSULATED PIPES	1	F-C-5004, F-C-5037, F-C-5036	CABLE TRAY	1	W-L-4011, W-L-4019, W-L-4081
				2	W-L-4011, W-L-4019, W-L-4081
				4	W-L 8014
	2	F-C-5004, F-C-5037		INSULATED PIPES	1
		2	W-L-5028, W-L-5029, W-L-5047		
		4	W-L-5073		
NON-INSULATED MECHANICAL DUCTWORK WITHOUT DAMPERS	1	F-C-7013	NON-INSULATED MECHANICAL DUCTWORK WITHOUT DAMPERS	1	W-L 7017, W-L-7040, W-L-7042, W-L-7155
INSULATED MECHANICAL DUCTWORK WITHOUT DAMPERS	1	N/A**	INSULATED MECHANICAL DUCTWORK WITHOUT DAMPERS	2	W-L-7040, W-L-7042, W-L-7155
	2	N/A**		1	W-L-7059, W-L-7153, W-L-7156, W-L-7151
MIXED PENETRANTS			MIXED PENETRANTS	2	W-L-7059, W-L-7153, W-L-7156, W-L-7151
	1	F-C-8009, F-C-8014, F-C-8026		1	W-L-1095, W-L-8013
				2	W-L-1095, W-L-8013
				4	W-L-8014

END OF SECTION 07 8413

SECTION 07 8443 - 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.
2. Joints at exterior curtain-wall/floor intersections.

B. Related Requirements:

1. Section 07 8100 "Applied Fireproofing" for fire-resistance of structural systems.
2. Section 07 8413 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and for wall identification.
3. Section 09 2216 "Non-Structural Metal Framing" for firestop tracks for metal-framed partition heads.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 REFERENCES

- A. Underwriters Laboratories, Inc. (UL) Fire Resistance Directory, Volume II, updated annually:
 1. Joint Systems (XHBN).
 2. Perimeter Fire Containment Systems (XHDG).
 3. Fire Resistance Ratings (BXRH).
 4. Fill, Voids or Cavity Material (XHHW).
 5. Forming Materials (XHKU).
- B. Omega Point Laboratories, Inc. (OPL) Listed Products Directory, Volume II, updated annually:
 1. Fire Resistant Joint Systems.
- C. ASTM E 1966, "Standard Test Method for Fire-Resistive Joint Systems".
- D. ANSI/UL 2079, "Tests for Fire Resistance of Building Joint Systems".

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Provide data that product has been tested in accordance with the requirements of either ASTM E 1966 or UL 2079.
 - 2. Submit safety data sheets provided with product delivered to job-site.
- B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.

1.6 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. Engineering Judgments: For those firestop applications that exist for which no tested and listed system is available through a manufacturer, an engineering judgment derived from similar tested system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment documents shall follow requirements set forth by the International Firestop Council.

1.7 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."
- B. A manufacturer's direct representative (not distributor or agent) to be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.

1.9 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.

1.10 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 JOINT FIRESTOPPING - GENERAL

- A. Provide firestopping composed of components that are compatible with each other and substrates forming joints under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.
- B. Provide components for each fire-resistive joint system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.
- C. 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.
- D. Joints in or between fire-rated construction: Provide joint firestopping systems with ratings determined per UL 2079 or ASTM E 1966:
 - 1. F-Rating: not less than the fire resistance rating of the construction they will join.
 - 2. Firestop Top Track Seal: For metal stud partitions installed on flat concrete slab use one-piece, pre-formed, polyurethane foam based, firestop seal for use with standard head-joint top tracks and bottom-joint tracks, and slip-type head joints in fire-rated construction at top or bottom of partition to maintain continuity of the fire-resistance-rated assembly indicated. Provide in width and configuration required to accommodate depth and installation of studs and designed to saddle-over the top track or under the bottom-track.
- E. Joints at exterior curtain wall/floor intersections: Provide joint firestopping systems with ratings determined per ASTM E 2307:
 - 1. F-rating: not less than the fire resistance rating of the construction they will joining.
 - 2. For edge slab conditions with a full height vision glass, or for conditions which do not contain an insulated spandrel at the floor line, only tested system HI/BPF 120-10 issued by Intertek Laboratories shall be used. If the tested system does not meet the project conditions, an engineering judgment derived from HI/BPF 120-10 shall be

submitted to local authorities having jurisdiction for their review and approval prior to installation.

- F. Joints in smoke barriers: Provide joint firestopping systems with ratings determined per UL 2079:
 - 1. L-Rating: Not exceeding 5.0 cfm/ft. of joint at both ambient and elevated temperatures.
- G. Joints at intersection between rated wall assemblies and non-rated horizontal assemblies: Provide joint firestopping systems with ratings determined by ASTM E 2837.
- H. Mold resistance: Provide joint firestopping system sealant with mold and mildew resistance rating of one (1) or less as determined by ASTM G21.
- I. Rain and water resistance: provide perimeter joint sealant tested in accordance with ASTM D 6904 with less than 1 hour tack free time as tested in accordance with ASTM C 679.

2.2 JOINT FIRESTOPPING SYSTEMS

- A. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.
 - 1. Basis-of-Design Product: Subject to compliance with joint systems (XHBN) listed in Volume II of the UL Fire Resistance Directory or OPL Listed Products Directory, provide Hilti, Inc.; or a comparable product by one of the following:
 - a. 3M Fire Protection Products.
 - b. Blazeframe Industries.
 - c. Grabber Construction Products.
 - d. NUCO Inc.
 - e. Passive Fire Protection Partners.
 - f. RectorSeal.
 - g. 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.

2.3 MATERIALS

- A. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- B. Accessories: Provide components of fire-resistive joint 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.
- C. Sealants, sprays, or pre-formed materials for use with fire-rated construction joints and other gaps, the following Basis-of-Design products are acceptable:

1. Hilti Firestop top Track Seal (CFS-TTS).
 2. Hilti Firestop Joint Spray (CFS-SP WB).
 3. Hilti Firestop Silicone Joint Spray (CFS-SP SIL).
 4. Hilti Flexible Firestop Sealant (CP 606).
 5. Hilti Firestop Silicone Sealant Gun Grade (CFS-S SIL GG).
 6. Hilti Firestop Silicone Sealant Self Leveling (CFS-S SIL SL).
 7. Hilti Bottom-of-Wall Sealant CP 605.
- D. Sealants for use of a Perimeter Fire Barrier System between fire-resistance-rated floors and exterior wall assemblies, the following Basis-of-Design products are acceptable:
1. Hilti Firestop Joint Spray (CFS-SP WB).
 2. Hilti Firestop Silicone Joint Spray (CFS-SP SIL).
 3. Hilti Firestop Silicone Sealant Gun Grade (CFS-S SIL GG).
 4. Hilti Firestop Sealant Self Leveling (CFS-S SIL SL).
- E. Pre-formed mineral wool designed to fit flutes of metal profile deck and gap between top of wall and metal deck profile; use as a backer for spray material, the following Basis-of-Design products are acceptable:
1. Hilti Speed Plugs (CP 777).
- F. Provide a firestop system with an assembly rating as determined by ASTM E 1966 and/or ANSI/UL 2079 which is equal to the fire-resistance ratings of the construction in which the joint occurs.

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. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Before installing fire-resistive joint 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 fire-resistive joint 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 fire-resistive joint 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 IDENTIFICATION

- A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 - 1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.
 - 3. Designation of applicable testing agency.
 - 4. Date of installation.
 - 5. Manufacturer's name.
 - 6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2393.

- 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.

3.6 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 fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

3.7 SCHEDULE OF MOST COMMON JOINT FIRESTOP SYSTEMS (BASIS-OF-DESIGN)

Schedule of joint firestop systems. Basis of design: Hilti, Inc.

Joint Type	F-Rating (Hr)	Hilti Basis of Design UL System	
		Joint Width Less than or Equal to 2"	Joint Width Greater than 2" Less than or Equal to 6" ⁴
Concrete (Floor to Floor)	1	FF-D-1012, FF-D-1013 ¹	FF-D-1012, FF-D-1013
	2	FF-D-1012, FF-D-1013 ¹	FF-D-1012, FF-D-1013
	3	FF-D-1011, FF-D-1026 ¹	FF-D-1011, FF-D-1026
	4	FF-D-1047	FF-D-1125
Concrete (Edge of Floor Slab to Wall)	1	FW-D-1011, FW-D-1012, FW-D-1013	FW-D-1011, FW-D-1012, FW-D-1013, FW-D-1021
	2	FW-D-1011, FW-D-1012, FW-D-1013	FW-D-1011, FW-D-1012, FW-D-1013, FW-D-1021
	3	FW-D-1011	FW-D-1011, FW-D-1021
	4	FW-D-1047	FW-D-1092
Concrete or Block Wall to Flat Concrete Floor (Top-of-Wall)	1	N/A**	N/A**
	2	HW-D-0097 ¹	HW-D-1009
	3	HW-D-1008 ¹ , HW-D-0268	HW-D-1008
	4	HW-D-1042	HW-D-1103
Concrete or Block Wall to Concrete Over Fluted Metal Deck (Top-of-Wall)	1	HW-D-0098	N/A**
	2	HW-D-0080, HW-D-0081, HW-D-0098	HW-D-1037
	3	N/A**	N/A**
	4	HW-D-0294	N/A**
Gypsum Wall to Flat Concrete Floor (Top-of-Wall)	1	HW-D-0757, HW-D-0082, HW-D-0083, HW-D-0106, HW-D-0119	HW-D-1011, HW-D-1012, HW-1020
	2	HW-D-0757, HW-D-0082, HW-D-0083, HW-D-0106, HW-D-0119	HW-D-1011, HW-D-1012, HW-1020
	3	HW-D-0119	HW-D-1011, HW-D-1012, HW-1020
Gypsum Shaft Wall to (Top-of-Wall)	2	HW-D-0342 (FLAT CONCRETE)	N/A**

		HW-D-0541, HW-D-0542 (CONCRETE OVER METAL DECK)	
Gypsum Shaft Wall to Concrete Floor (Bottom-of-Wall)	1	BW-S-0023	N/A**
	2	BW-S-0023	N/A**
Gypsum Wall to Concrete Floor (Bottom-of-Wall)	1	BW-S-0001, BW-S-0002, BW-S-0039	N/A**
	2	BW-S-0001, BW-S-0002, BW-S-0039	N/A**
Gypsum Wall to Concrete Over Fluted Metal Deck (Top-of-Wall)	1	HW-D-0042*, HW-D-0049*, HW-D-0087*, HW-D-0089*, HW-D-0045, HW-D-0046*, HW-D-0076*, HW-D-0077*, HW-D-0154, HW-D-0184*, HW-D-0292, HW-D-0295, HW-D-538*	HWD-1011, HWD-1012, HWD-1020
	2	HW-D-0042*, HW-D-0049*, HW-D-0087*, HW-D-0089*, HW-D-0045, HW-D-0046*, HW-D-0076*, HW-D-0077*, HW-D-0154, HW-D-0184*, HW-D-292, HW-D-0295, HW-D-0538*	HW-D-1011, HW-D-1012, HW-D-1020
	3	HW-D-0292, HW-D-0295	HWD-1011, HWD-1012, HWD-1020
	4	HW-D-0292, HW-D-0295	N/A**
Concrete (Wall to Wall)	2	WW-D-0017, WW-D-0082	WW-D-1080, WW-D-1084
	3	WW-D-1011 ¹ , WW-D-0032	WW-D-1011
	4	WW-D-1047	WW-D-1128
Gypsum to Concrete (Wall to Wall)	1	WW-D-0040	N/A**
	2	WW-D-0040	N/A**

* SEE NOTE 3 ** CONTACT HILTI FOR CURRENT UL-CLASSIFIED SYSTEM OR ENGINEER JUDGMENT DRAWING: 800-879-8000NOTES:

1. CLASSIFIED SYSTEMS FOR 2" - 6" WIDE JOINTS MAY BE USED FOR JOINTS 2" WIDE AND LESS.
2. CONFIRM THAT MOVEMENT CAPABILITIES OF THE SELECTED UL SYSTEM MEETS OR EXCEEDS THE SPECIFIED MOVEMENT RANGE OF THE PARTICULAR JOINT.
3. SYSTEMS MARKED WITH ASTERIK (*) ARE SUITABLE FOR TOP-OF-WALL JOINTS WHERE THE FLUTED METAL DECK HAS SPRAY-ON MONOKOTE MK-6/HY FIREPROOFING.
4. VERIFY ALLOWABLE JOINT WIDTH ON SPECIFIC UL SYSTEM DRAWING.

END OF SECTION 07 8443

SECTION 07 9200 - 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. This Section includes joint sealants for the following applications:
 - 1. Exterior joints in the following vertical surfaces and horizontal nontraffic surfaces:
 - a. See "Locations" at the end of this section.
 - 2. Exterior joints in the following horizontal traffic surfaces:
 - a. See "Locations" at the end of this section.
 - 3. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:
 - a. See "Locations" at the end of this section.
 - 4. Interior joints in the following horizontal traffic surfaces:
 - a. See "Locations" at the end of this section.
- B. Related Sections include the following:
 - 1. Division 07 Section "Fire-Resistive Joint Systems" for sealing joints in fire-resistance-rated construction.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. Provide joint sealants for interior applications that establish and maintain airtight continuous joint seals without staining or deteriorating joint substrates.

1.4 SUBMITTALS

- A. Manufacturer's installation instructions for each product.

- 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. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Manufacturer's Literature and Data:
 - 1. Caulking compound.
 - 2. Primers.
 - 3. Sealing compound, each type, including compatibility when different sealants are in contact with each other.
- E. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- C. Product Testing: Obtain test results from a qualified testing agency based on testing current sealant formulations within a 12-month period.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021.
 - 2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C920, and where applicable, to other standard test methods.
 - 3. Test other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.
- D. VOC: Acrylic latex and Silicon sealants shall have less than 50g/l VOC content.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations:
 - 1. Do not proceed with installation of joint sealants under following conditions:

- a. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 deg. F.
 - b. When joint substrates are wet.
 - B. Joint-Width Conditions:
 1. Do not proceed with installation of joint where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
 - C. Joint-Substrate Conditions:
 1. Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.
- 1.7 DELIVERY, HANDLING, AND STORAGE:
 - A. Deliver materials in manufacturers' original unopened containers, with brand names, date of manufacture, shelf life, and material designation clearly marked thereon.
 - B. Carefully handle and store to prevent inclusion of foreign materials.
 - C. Do not subject to sustained temperatures exceeding 90° F or less than 40° F.
- 1.8 DEFINITIONS
 - A. Definitions of terms in accordance with ASTM C717 and as specified.
 - B. Back-up Rod: A type of sealant backing.
 - C. Filler: A sealant backing used behind a back-up rod.
- 1.9 WARRANTY
 - A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric 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's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those 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.
 - C. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:

1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

1.10 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - C509-06Elastomeric Cellular Prefomed Gasket and Sealing Material.
 - C612-10Mineral Fiber Block and Board Thermal Insulation.
 - C717-10Standard Terminology of Building Seals and Sealants.
 - C834-10Latex Sealants.
 - C919-08.Use of Sealants in Acoustical Applications.
 - C920-10Elastomeric Joint Sealants.
 - C1021-08Laboratories Engaged in Testing of Building Sealants.
 - C1193-09Standard Guide for Use of Joint Sealants.
 - C1330-02 (R2007)Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.
 - D1056-07.....Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.
 - E84-09Surface Burning Characteristics of Building Materials.
- C. Sealant, Waterproofing and Restoration Institute (SWRI). The professional's Guide.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Basis-of-Design Product: The design is based on the product named in the basis-of-design and within the Construction Drawings. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified and based on substitution request approval.
- B. See Div 01 Section 01 2500 for "Substitution Procedures".

2.2 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
- B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Architectural Sealants: 250 g/L.
 - 2. Nonmembrane Roof Sealants: 300 g/L.
 - 3. Single-Ply Roof Membrane Sealants: 450 g/L.
 - 4. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 5. Sealant Primers for Porous Substrates: 775 g/L.
 - 6. Modified Bituminous Sealant Primers: 500 g/L.
- C. Colors of Exposed Joint Sealants: See "Joint Sealant" Schedule.

2.3 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- C. Suitability for Immersion in Liquids. Where elastomeric sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247 and qualify for the length of exposure indicated by reference to ASTM C 920 for Class 1 or 2. Liquid used for testing sealants is deionized water, unless otherwise indicated.
- D. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- E. Single-Component Neutral-Curing Silicone Sealant **ES-1**:
 - 1. Available Products:
 - a. Basis-of-Design: Dow Corning Corporation; 790.
 - b. GE Silicones; SilPruf LM SCS2700.
 - c. Tremco; Spectrem 1 (Basic).
 - d. GE Silicones; SilPruf SCS2000.
 - e. Pecora Corporation; 864.
 - f. Pecora Corporation; 890.

- g. Polymeric Systems Inc.; PSI-641.
 - h. Sonneborn, Division of ChemRex Inc.; Omniseal.
 - i. Tremco; Spectrem 3.
 - 2. Type and Grade: S (single component) and NS (nonsag).
 - 3. Class: 100/50.
 - 4. Use Related to Exposure: NT (nontraffic).
 - 5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
 - a. Use O Joint Substrates: See Joint Schedule for listing applicable joints.
 - 6. Stain-Test-Response Characteristics: Nonstaining to porous substrates per ASTM C 1248.
- F. Single-Component Mildew-Resistant Neutral-Curing Silicone Sealant **ES-2**:
 - 1. Available Products:
 - a. Basis-of-Design: Pecora Corporation; 898.
 - b. Tremco; Tremsil 600 White.
 - 2. Type and Grade: S (single component) and NS (nonsag).
 - 3. Class: 25.
 - 4. Use Related to Exposure: NT (nontraffic).
 - 5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
 - a. Use O Joint Substrates: See Joint Schedule for listing of applicable joints.
- G. Single-Component Mildew-Resistant Acid-Curing Silicone Sealant **ES-3**:
 - 1. Available Products:
 - a. Basis-of-Design: Dow Corning Corporation; 786 Mildew Resistant.
 - b. GE Silicones; Sanitary SCS1700.
 - c. Tremco; Tremsil 200.
 - 2. Type and Grade: S (single component) and NS (nonsag).
 - 3. Class: 25.
 - 4. Use Related to Exposure: NT (nontraffic).
 - 5. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.
 - a. Use O Joint Substrates: See Joint Schedule for listing of applicable joints.

2.4 SOLVENT-RELEASE JOINT SEALANTS

- A. Butyl-Rubber-Based Solvent-Release Joint Sealant **SRS-1**: Comply with ASTM C 1311.

- 1. Available Products:

- a. Bostik Findley; Bostik 300.
- b. Fuller, H. B. Company; SC-0296.
- c. Fuller, H. B. Company; SC-0288.
- d. Basis-of-Design: Pecora Corporation; BC-158.
- e. Polymeric Systems Inc.; PSI-301
- f. Sonneborn, Division of ChemRex Inc.; Sonneborn Multi-Purpose Sealant.
- g. Tremco; Tremco Butyl Sealant.

2.5 LATEX JOINT SEALANTS

- A. Latex Sealant **LS-1**: Comply with ASTM C 834, Type P, Grade NF.

1. Available Products:

- a. Basis-of-Design: DAP Products Inc; ALEX Painter's Acrylic Latex Caulk.
- b. GE Siliconized acrylic; Painters; GE14449.

- B. Latex Sealant **LS-2**: Comply with ASTM C 834, Type P, Grade NF.

1. Available Products:

- a. Basis-of-Design: DAP Products Inc; ALEX PLUS Painter's Acrylic Latex Caulk.
- b. Bostik Findley; Chem-Calk 600.Pecora Corporation; AC-20+.
- c. Schnee-Morehead, Inc.; SM 8200.
- d. Sonneborn, Division of ChemRex Inc.; Sonolac.
- e. Tremco; Tremflex 834.

2.6 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) O (open-cell material) B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.7 MISCELLANEOUS MATERIALS

- A. Primer: Material 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.
- 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. Provide sealant at every joint between two dissimilar materials, unless noted otherwise.
- B. 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.
- C. Coordinate for repair and resolution of unsound substrate materials.
- D. Inspect for uniform joint widths and that dimensions are within tolerance established by sealant manufacturer.

3.2 PREPARATION

- A. Prepare joints in accordance with manufacturer's instructions and SWRI.
- B. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.

- b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
- 3. Remove laitance and form-release agents from concrete.
- 4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- C. Do not cut or damage joint edges.
- D. Apply masking tape to face of surfaces adjacent to joints before applying primers, caulking or sealing compounds.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- E. Apply primer to sides of joints wherever required by compound manufacturer's printed instructions.
 - 1. Apply primer prior to installation of back-up rod or bond breaker tape.
 - 2. Use brush or other approved means that will reach all parts of joints.
- F. Take all necessary steps to prevent three sided adhesion of sealants.

3.3 BACKING INSTALLATION

- A. Install back-up material, to form joints enclosed on three sides as required for specified depth of sealant.
- B. Where deep joints occur, install filler to fill space behind the back-up rod and position the rod at proper depth.
- C. Cut fillers installed by others to proper depth for installation of back-up rod and sealants.
- D. Install back-up rod, without puncturing the material, to a uniform depth, within plus or minus 1/8-inch- for sealant depths specified.
- E. Where space for back-up rod does not exist, install bond breaker tape strip at bottom (or back) of joint so sealant bonds only to two opposing surfaces.
- F. Take all necessary steps to prevent three sided adhesion of sealants.

3.4 SEALANT DEPTHS AND GEOMETRY

- A. At widths up to 1/4-inch-, sealant depth equal to width.
- B. At widths over 1/4-inch-, sealant depth 1/2 of width up to 1/2-inch- maximum depth at center of joint with sealant thickness at center of joint approximately 1/2 of depth at adhesion surface.

3.5 INSTALLATION OF JOINT SEALANTS

- A. General:
 - 1. Apply sealants and caulking only ambient temperature is between 40 deg and 100 deg F.
 - 2. Do not use polysulfide base sealants where sealant may be exposed to fumes from bituminous materials, or where water vapor in continuous contact with cementitious materials may be present.
 - 3. Do not use sealant type listed by manufacture as not suitable for use in locations specified.
 - 4. Apply caulking and sealing compound in accordance with manufacturer's printed instructions.
 - 5. Avoid dropping or smearing compound on adjacent surfaces.
 - 6. Fill joints solidly with compound and finish compound smooth.
 - 7. Tool joints to concave surface unless shown or specified otherwise.
 - 8. Finish paving or floor joints flush unless joint is otherwise detailed.
 - 9. Apply compounds with nozzle size to fit joint width.
 - 10. Test sealants for compatibility with each other and substrate. Use only compatible sealant.
- 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. Where gypsum board partitions are of sound rated or fire rated follow requirements of ASTM C919 only to seal all cut-outs and intersections with the adjoining construction unless specified otherwise.
 - 1. Apply a 1/4-inch- minimum bead of sealant each side of runners (tracks), including those used at partition intersections with dissimilar wall construction.
 - 2. Coordinate with application of gypsum board to install sealant immediately prior to application of gypsum board.
 - 3. Partition intersections: Seal edges of face layer of gypsum board abutting intersecting partitions, before taping and finishing or application of veneer plaster-joint reinforcing.
 - 4. Openings: Apply a 1/4-inch- bead of sealant around all cut-outs to seal openings of electrical boxes, ducts, pipes and similar penetrations. To seal electrical boxes, seal sides and backs.
 - 5. Control Joints: Before control joints are installed, apply sealant in back of control joint to reduce flanking path for sound through control joint.

3.6 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed elastomeric sealant joints as follows:
 - a. Perform 10 tests for the first 1000 feet of joint length for each type of elastomeric sealant and joint substrate.
 - b. Perform 1 test for each 1000 feet of joint length thereafter or 1 test per each floor per elevation.
2. Test Method: Test joint sealants according to in Appendix X1 in ASTM C 1193, as appropriate for type of joint-sealant application indicated.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; do this by extending cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
3. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field-adhesion-test log.
4. Inspect tested joints and report on the following:
 - a. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
 - b. Whether sealants filled joint cavities and are free of voids.
 - c. Whether sealant dimensions and configurations comply with specified requirements.
5. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
6. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.7 CLEANING

- A. Fresh compound accidentally smeared on adjoining surfaces: Scrape off immediately and rub clean with a solvent as recommended by the caulking or sealant manufacturer.
- B. After filling and finishing joints, remove masking tape.

- C. Leave adjacent surfaces in a clean and unstained condition.

3.8 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 so installations with repaired areas are indistinguishable from original work.

3.9 JOINT-SEALANT SCHEDULE

- A. General: For recommended products for each corresponding **Type** see those listed in the "Products" above.
- B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces: **Type ES-1**.
 - 1. Joint Locations:
 - a. Construction joints in cast-in-place concrete.
 - b. Joints between plant-precaster architectural concrete units.
 - c. Control and expansion joints in unit masonry.
 - d. Joints in dimension stone cladding.
 - e. Joints in glass unit masonry assemblies.
 - f. Joints in exterior insulation and finish systems.
 - g. Joints in portland cement plastering systems.
 - h. Joints between metal panels.
 - i. Joints in wood siding.
 - j. Joints in fiber-cement siding.
 - k. Joints between different materials listed above.
 - l. Perimeter joints between materials listed above and frames of doors windows and louvers.
 - 2. Joint-Sealant Color:
 - a. If color not selected during submittal process provide color to match that of one of the adjacent surface(s).
 - b. If the two options above do not provide the right color provide clear.
- C. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement: **Type IS-2**.
 - 1. Joint Locations:
 - a. Control joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints between interior wall surfaces and frames of interior doors windows, elevator entrances and baseboards.

1. Joint-Sealant Color: If color not selected during submittal process provide color to match that of one of the adjacent surface(s).
- D. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces: **Type ES-2 or ES-3** (Depending on substrate compatability).
1. Joint Locations:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control and expansion joints where indicated.
 2. Joint-Sealant Color:
 - a. Countertops: Match color of countertop or clear.
 - b. Plumbing Fixtures: Match color of fixture.
- E. Joint-Sealant Application: Concealed mastics: **Type SRS-1**.
1. Joint Locations:
 - a. Aluminum thresholds.
 - b. Sill plates.
 2. Joint-Sealant Color: As indicated by manufacturer's designations.

END OF SECTION 07 9200

SECTION 08 1113 - 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. Standard hollow metal doors and frames.
2. Interior knocked down frames.

B. Related Sections:

1. Division 04 Section "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
2. Division 08 Section "Sound Control Door Assemblies" for packaged, acoustical hollow metal door and frame assemblies with STC ratings of 35 or more.
3. Division 08 Section "Door Hardware" for door hardware for hollow metal doors.
4. Division 09 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.
5. Division 26 Sections for electrical connections including conduit and wiring for door controls and operators.

1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings.
- B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.
- C. Custom Hollow Metal Work: Hollow metal work fabricated according to ANSI/NAAMM-HMMA 861.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, temperature-rise ratings, and finishes.
- B. Shop Drawings: Include the following:
 1. Elevations of each door design.

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 anchorages, joints, field splices, and connections.
 7. Details of accessories.
 8. Details of moldings, removable stops, and glazing.
 9. Details of conduit and preparations for power, signal, and control systems.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Other Action Submittals:
1. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

1.5 INFORMATIONAL SUBMITTALS

- A. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of hollow metal door and frame assembly.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.
- B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252.
1. Temperature-Rise Limit: Where indicated, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.
- C. Smoke-Control Door Assemblies: Comply with NFPA 105 or UL 1784.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.
1. Provide additional protection to prevent damage to finish of 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 work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch-high wood blocking. Do not store in a manner that traps excess humidity.
 - 1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.9 COORDINATION

- A. Coordinate installation of anchorages 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.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Basis-of-Design Product: The design is based on the product named in the basis-of-design and within the Construction Drawings. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified and based on substitution request approval.
- B. See Div 01 Section 01 2500 for "Substitution Procedures".

2.2 MANUFACTURERS

- A. 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:
 - 1. Amweld Building Products, LLC.
 - 2. Benchmark; a division of Therma-Tru Corporation.
 - 3. Ceco Door Products; an Assa Abloy Group company.
 - 4. Curries Company; an Assa Abloy Group company.
 - 5. Deansteel Manufacturing Company, Inc.
 - 6. Firedoor Corporation.
 - 7. Fleming Door Products Ltd.; an Assa Abloy Group company.
 - 8. Habersham Metal Products Company.
 - 9. Karpen Steel Custom Doors & Frames.

10. Kewanee Corporation (The).
11. Mesker Door Inc.
12. Pioneer Industries, Inc.
13. Security Metal Products Corp.
14. Steelcraft; an Ingersoll-Rand company.
15. Windsor Republic Doors.

2.3 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z coating designation; mill phosphatized.
 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- E. Powder-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. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.
- G. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- H. Glazing: Comply with requirements in Division 08 Section "Glazing."
- I. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.4 STANDARD HOLLOW METAL DOORS

- A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.
 1. Design: As indicated.

2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.
 - a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
 - b. Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 4.0 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.
 - 1) Locations: Exterior doors and interior doors where indicated.
 3. Vertical Edges for Single-Acting Doors: Beveled edge.
 - a. Beveled Edge: 1/8 inch in 2 inches.
 4. Vertical Edges for Double-Acting Doors: Round vertical edges with 2-1/8-inch radius.
 5. Top and Bottom Edges: Closed with flush or inverted 0.042-inch-thick, end closures or channels of same material as face sheets.
 6. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
1. Level 2 and Physical Performance Level B (Heavy Duty), Model 2 (Seamless).
- C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
1. Level 1 and Physical Performance Level C (Standard Duty), Model 2 (Seamless).
 - a. Width: 1-3/4 inches.
- D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.
- 2.5 INTERIOR FRAMES
- A. Construct interior frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Standard-Duty Frames SDI A250.8 and with details indicated for type and profile.
1. Interior Frames: (Listed in the Door Schedule as "Hollow Metal")

- a. Physical Performance: Level C according to SDI A250.4.
 - b. Materials: Fabricated from uncoated, cold-rolled steel sheet, minimum thickness of 0.042 inch (18 gauge).
 - c. Sidelite and Transom Frames: Fabricate from same thickness material as adjacent door frame.
 - d. Construction: Full flush and seamless, full perimeter channel, continuously welded door edge. Standard Honeycomb core.
 - e. Exposed Finish: Cleaned, phosphatized and painted with one coat of gray baked enamel primer, ready for finish painting.
2. Interior Frames: (Listed in the Door Schedule as "Knocked Down" - KD)
- a. Basis-of-Design product manufacturer: Subject to compliance with requirements provide Knocked Down frames from Timely Industries; www.timelyframes.com.
 - 1) "C" Series 1.2 mm (18 gage) thick.
 - 2) ASTM E 152 Methods of Fire Tests of Door Assemblies.
 - 3) NFPA 80 Fire Doors and Windows.
 - 4) NFPA 252 1995 Fire Tests of Door Assemblies.
 - 5) UL 10B Fire Tests of Door Assemblies.
 - 6) UL 10C Positive Pressure Fire Tests of Door Assemblies.
 - 7) Cold rolled steel, electro-galvanized for exterior frames.
 - 8) Standard Steel Frame Type: Fit factory assembled units with MiterGard corner alignment clips. Provide NHOS (Nail Holes Oval Slots for wood trim.)
 - 9) Reinforcement Bracket for Closer: Verify with hardware schedule.
 - 10) Casing Clips: Fabricate frames with factory applied heated treated clips.
 - 11) Fabricate frames with hinge reinforcement plates secured in place.
 - 12) Attach fire rated label to each fire-rated frame.
 - 13) Install as per manufacturer's specifications and recommendations. Use manufacturer's certified installers.
 - 14) Coordinate frame installation with door hardware.
 - 15) Cleaned, phosphatized and painted with one coat of gray baked enamel primer, ready for finish painting. See drawings for wood trim details and/or jamb and head trim details.

- C. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

2.6 EXTERIOR FRAMES

- A. Construct exterior frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Frames: SDI A250.8, Level 2. (Listed in the Door Schedule as "Hollow Metal")
 - 1. Physical Performance: Level B according to SDI A250.4.
 - 2. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (16 gauge, with minimum A40 coating).

3. Side-lite and Transom Frames: Fabricate from same thickness material as adjacent door frame.
4. Construction: Full flush and seamless, full perimeter channel, continuously welded door edge. Standard Honeycomb core.
5. Exposed Finish: Cleaned, phosphatized and painted with one coat of gray baked enamel primer, ready for finish painting.

2.7 FRAME ANCHORS

A. Jamb Anchors:

1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.

2.8 HOLLOW METAL PANELS

- ### A. Provide hollow metal panels of same materials, construction, and finish as specified for adjoining hollow metal work.

2.9 STOPS AND MOLDINGS

- ### A. Moldings for Glazed Lites in Doors: Minimum 0.032inch thick, fabricated from same material as door face sheet in which they are installed.
- ### B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.
- ### C. Loose Stops for Glazed Lites in Frames: Minimum 0.032inch thick, fabricated from same material as frames in which they are installed.
- ### D. Terminated Stops: Where indicated on interior door frames, terminate stops 6 inches above finish floor with a 45-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.
1. Provide terminated stops where indicated.

2.10 LOUVERS

- ### A. Provide louvers for interior doors, where indicated, that comply with SDI 111C, with blades or baffles formed of 0.020-inch-thick, cold-rolled steel sheet set into 0.032-inch-thick steel frame.
1. Sightproof Louver: Stationary louvers constructed with inverted V-shaped or Y-shaped blades.
 2. Lightproof Louver: Stationary louvers constructed with baffles to prevent light from passing from one side to the other, any angle.
 3. Fire-Rated Automatic Louvers: Louvers constructed with movable blades closed by actuating fusible link, and listed and labeled for use in fire-rated door

assemblies of type and fire-resistance rating indicated by same testing and inspecting agency that established fire-resistance rating of door assembly.

2.11 FABRICATION

- A. 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 thickness of metal. 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.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/NAAMM-HMMA 861.
- C. Hollow Metal Doors:
 - 1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
 - 2. Glazed Lites: Factory cut openings in doors.
 - 3. 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.
- D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 - 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.
 - 4. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 - 5. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches high.
 - 2) Four anchors per jamb from 60 to 90 inches high.
 - 3) Five anchors per jamb from 90 to 96 inches high.
 - 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
 - 5) Two anchors per head for frames above 42 inches wide and mounted in metal-stud partitions.
 - b. Compression Type: Not less than two anchors in each jamb.
 - c. 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 doors, 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, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.
 - F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
 1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
 2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
 4. 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 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 type of glazing and type of installation indicated.
- 2.12 STEEL FINISHES
- A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; 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. For the record, 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.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:
 - 1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - 2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - 3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - 4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.
 - 1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-protection-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.

- c. Install frames with removable glazing stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
 4. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 5. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
 6. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb 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 hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Standard Steel Doors:
 - a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
 - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 3. Smoke-Control Doors: Install doors according to NFPA 105.
- D. Glazing: Comply with installation requirements in Division 08 Section "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 ADJUSTING AND CLEANING

- 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 Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 08 1113

SECTION 08 1416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-core doors with wood-veneer faces.

B. Related Sections:

1. Division 08 Section "Hollow Metal Door and Frames".

1.2 SUBMITTALS

A. Product Data: For each type of door indicated

B. Sustainable Design Submittals:

1. Product Certificates: For materials manufactured within 100 miles of Project, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each raw material.
2. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
3. Chain-of-Custody Qualification data: For Manufacturer and vendor.
4. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
5. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.

1. Indicate dimensions and locations of cutouts.
2. Indicate requirements for veneer matching.
3. Indicate fire-protection ratings for fire-rated doors.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.

B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

- C. Quality Standard: In addition to requirements specified, comply with AWI's "Architectural Woodwork Quality Standards Illustrated.
- D. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to UBC Standard 7-2.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide: VT Industries, Inc- Architectural Wood Doors: with specifications listed in 2.3-A or comparable product and finish by one of the following:
 - 1. Algoma Hardwoods, Inc.
 - 2. Eggers Hardwood Products Corporation.
 - 3. Graham; an Assa Abloy Group company.
 - 4. Ideal Architectural Doors & Plywood.
 - 5. Marshfield Door Systems, Inc.
 - 6. Poncraft Door Company.
 - 7. VT Industries, Inc.
 - 8. Weyerhaeuser, Inc.
- B. Regional Materials: Wood doors shall be manufactured within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of project site.
- C. Certified Wood: Wood doors shall be certified as "FSC Pure" according to FSC STD-001 and FSC STD-40-004.
- D. Adhesives: Use adhesives that meet 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."
- E. Composite Wood Products: Products shall be 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 shall be made with no added formaldehyde.

2.2 DOOR CONSTRUCTION, GENERAL

- A. Low-Emitting Materials: Provide doors made with adhesives and composite wood products that do not contain urea formaldehyde.
- B. WDMA I.S.1-A Performance Grade:
 - 1. Heavy Duty unless otherwise indicated.

C. Particleboard-Core Doors:

1. Particleboard: ANSI A208.1, Grade LD-1, made with binder containing no urea-formaldehyde resin.
2. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
3. Provide doors with either glued-wood-stave or structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.

D. Fire-Protection-Rated Doors: Provide core specified or mineral core as needed to provide fire-protection rating indicated.

1. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.

2.3 VENEERED-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors:

1. Grade: Grade A veneer.
2. Species: Red Oak, SRO.
3. Stain: As selected from manufacturers standard range of colors.
4. Cut: Plain Sliced.
5. Match between Veneer Leaves: Book-Match.
6. Assembly of Veneer on door face: Running Match.
7. Construction: Five ply, made up of 2 face veneers and crossbands, all securely bonded to the core by the hot-press method in one operation, utilizing Type I waterproof adhesive.

2.4 LOUVERS AND LIGHT FRAMES

A. Light Frames:

1. Metal and Finish: Hot-dip galvanized steel, 0.040inch thick, factory primed for paint finish.

2.5 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

1. Comply with requirements in NFPA 80 for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied.

C. Openings: Cut and trim openings through doors in factory.

1. Louvers: Factory install louvers in prepared openings.

2.6 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 - 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors that are indicated to receive transparent finish.
- C. Use only paints and coatings that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Transparent Finish:
 - 1. Grade: Premium.
 - 2. Finish: AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" System 10, UV curable, water based.
 - 3. Staining: As selected by Architect from manufacturer's full range.
 - 4. Effect: Open-grain finish.
 - 5. Sheen: Satin.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Hardware: For installation, see Division 08 Section "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.
 - 1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 - 1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
 - a. Comply with NFPA 80 for fire-rated doors.
- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

END OF SECTION 08 1416

SECTION 08 3323 - OVERHEAD SECTIONAL 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. Service doors.
2. Insulated service doors.

B. Related Requirements:

1. Section 05 5000 "Metal Fabrications" for miscellaneous steel supports, door-opening framing, corner guards, and bollards.
2. Section 11 1200 "Parking Control Equipment" for parking control equipment interlocked to overhead coiling doors.
3. Division 26. Electrical wiring and conduit, fuses, disconnect switches, connection of operator to power supply, and installation of control station and wiring.

1.3 ACTION SUBMITTALS

A. Product Data: For each type and size of overhead coiling 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.
3. Include description of automatic-closing device and testing and resetting instructions.

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. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.

5. Show locations of controls, locking devices, detectors or replaceable fusible links, and other accessories.
 6. 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 and testing and inspecting agency.
1. Submit copy of DHI Fire and Egress Door Assembly Inspector (FDAI) certificate.
- B. Oversize Construction Certification: For door assemblies required to be fire-rated and that exceed size limitations of labeled assemblies.
- C. Sample Warranty: For special warranty.
- 1.5 CLOSEOUT SUBMITTALS
- A. Special warranty.
- B. Maintenance Data: For overhead coiling doors to include in maintenance manuals.
- 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.
- 1.7 WARRANTY
- A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.
1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.
 - 1. Obtain operators and controls from overhead coiling-door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance, Exterior Doors: Capable of withstanding the following design wind loads:
 - 1. Design Wind Load: Uniform pressure (velocity pressure) of 20 lbf/sq. ft., acting inward and outward.
 - 2. Testing: According to ASTM E330/E330M.
 - 3. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.
 - 4. Operability under Wind Load: Design overhead coiling doors to remain operable under uniform pressure (velocity pressure) of 20-lbf/sq. ft. wind load, acting inward and outward.
- B. Seismic Performance: Overhead coiling doors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. Component Importance Factor: 1.0.

2.3 DOOR ASSEMBLY (Doors 107A, 107B, 107C 107F, 107G, 107H)

- A. Service and Insulated Service Door: Aluminum Glass Sectional Door Series 521 by Overhead Door Corporation as bases of design.
 - 1. Manufacturers: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advanced Door Technologies.
 - b. Clopay Building Products.
 - c. Cookson Company.
 - d. Cornell.
 - e. Overhead Door Corporation.
 - f. Raynor.
- B. Operation Cycles: Door components and operators capable of operating for not less than 75,000 (75k) springs. 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. Air Infiltration: Maximum rate of 0.4 cfm/sq. ft. at 15 and 25 mph when tested according to ASTM E283 or DASMA 105.

- D. Material: 6063-T6 Aluminum. Color shall be Red
- E. R-Value: R-4.1 Insulated Rails, Stiles and infill Panels.
- F. Door Infill Panels: Aluminum with pre-finished surface per architects' selection from manufacturers full range of standard powder coat colors.
- G. Window Glazing: 1/2 inch Low-E insulated glass.
- H. Door Seal Weatherstripping:
 - 1. Flexible Bulb-Type strip at continuous along bottom section.
 - 2. Flexible Head seals.
 - 3. Flexible Jamb seal.
- I. Door Rails and Stiles:
 - 1. Center Stile width – 2 11/16 inch.
 - 2. End Stile width – 3 5/16 inch.
 - 3. Top Rail width – 2 3/8 inch.
 - 4. Top Intermediate Rail width – 2 1/8 inch.
 - 5. Bottom Intermediate Rail width – 1 19/32 inch.
 - 6. Bottom Rail width – 4 1/2 inch.
- J. Track: 3 inches.
- K. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.
- L. Locking Devices: Equip door with locking device assembly.
 - 1. Locking Device Assembly: Single-jamb side locking bars, operable from inside with thumb turn.
- M. Electric Motor Door Operator: Provide UL listed electric operator, size and type as recommended by Door Manufacturer to move the door in either direction at not less than 2/3 foot nor more than 1 foot per second. Operator shall meet UL 325/2010 requirements for continuous monitoring of safety devices.
 - 1. Entrapment Protection: Required for momentary contact, includes radio control operation, Photoelectric sensors monitored to meet UL 325/2010.
- N. Control:
 - 1. Push-Button operated control stations at each door location with OPEN, CLOSE and STOP buttons. Located on inside of Apparatus Bay adjacent to door with surface mounted installation.
 - 2. Special Operation: Vehicle Detector Operation from the exterior of the building shall be by Commercial Operator Radio Transmitter located in vehicle. Provide

enough Transmitters to supply the fleet of vehicles using Station #54. Verify quantity with Fire Chief.

2.4 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.

2.5 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 standard with manufacturer and keyed to building keying system.
 - 2. Keys: Three for each cylinder.
- B. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.6 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 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.

2.7 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. Top-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on top of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Headroom is required for this type of mounting.
 2. 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.
 3. Wall Mounted: Operator is mounted to the inside front wall on the left or right side of door and connected to door drive shaft with drive chain and sprockets. Side room is required for this type of mounting. Wall-mounted operator can also be mounted above or below shaft; if above shaft, headroom is required.
 4. Bench Mounted: Operator is mounted to the right or left door head plate and connected to the door drive shaft with drive chain and sprockets. Side room is required for this type of mounting.
 5. Through-Wall Mounted: Operator is mounted on other side of wall from coil side of door.
- 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 fire-rated doors, activation delays closing.

1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.
 - a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained or constant pressure on close button.
- 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. Interior-Mounted Units: 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.
- K. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with the accessibility standard.

2.8 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.

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 overhead sectional 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 overhead sectional doors, controls, and operators at the mounting locations indicated for each door.
- C. Accessibility: Install overhead sectional doors, switches, and controls along accessible routes in compliance with the accessibility standard.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and to furnish reports to Architect.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Test door release, closing, and alarm operations when activated by smoke detector or building's fire-alarm system. Test manual operation of closed door. Reset door-closing mechanism after successful test.
 - 2. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, section 5.2.
- 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 and NFPA 101.

3.4 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.

3.5 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
 - 1. Adjust exterior doors and components to be weather resistant.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide tight fit around entire perimeter.

3.6 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.
 - 2. Include 24-hour-per-day, seven-day-per-week, emergency callback service.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 08 3323

SECTION 08 41 13 – ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Exterior storefront framing.
2. Storefront framing for window walls.
3. Exterior manual-swing entrance doors and door-frame units.
4. Exterior Bi-Fold doors

B. Related Sections:

1. Division 08 Section "Door Hardware" for hardware not specified herein.
2. Division 08 Section "Glazing" for glazing to be used per location.

1.3 DEFINITIONS

- A. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:

1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
2. Dimensional tolerances of building frame and other adjacent construction.
3. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Thermal stresses transferring to building structure.

- c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
 - d. Glazing-to-glazing contact.
 - e. Noise or vibration created by wind and by thermal and structural movements.
 - f. Loosening or weakening of fasteners, attachments, and other components.
 - g. Sealant failure.
 - h. Failure of operating units.
- B. Delegated Design: Design aluminum-framed systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Structural Loads:
 1. Wind Loads: As indicated on Drawings.
 - a. Basic Wind Speed: 90 mph.
 - b. Importance Factor: 1.0.
 - c. Exposure Category: B.
 2. Seismic Loads: As indicated on Drawings.
- D. Deflection of Framing Members:
 1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed $L/175$ of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to $3/4$ inch, whichever is less.
 2. Deflection Parallel to Glazing Plane: Limited to $L/360$ of clear span or $1/8$ inch, whichever is smaller.
- E. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:
 1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
 2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
 3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.
- F. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft..
- G. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..

- H. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
 - 2. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
 - a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F.
 - b. Low Exterior Ambient-Air Temperature: 0 deg F.
 - 3. Interior Ambient-Air Temperature: 75 deg F.
- I. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 54 when tested according to AAMA 1503.
- J. Thermal Conductance: Provide aluminum-framed systems with fixed glazing and framing areas having an average U-factor of not more than 0.33 Btu/sq. ft. x h x deg F when tested according to AAMA 1503.
- K. Sound Transmission: Provide aluminum-framed systems with fixed glazing and framing areas having the following sound-transmission characteristics:
 - 1. Sound Transmission Class (STC): Minimum 35 STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.
 - 2. Outdoor-Indoor Transmission Class (OITC): Minimum 30 OITC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 1332.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.
- B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
 - 2. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.
- C. Samples for Initial Selection: For units with factory-applied mill or clear anodized finishes.
- D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

- E. Fabrication Sample: Of each vertical-to-horizontal intersection of aluminum-framed systems, made from 12-inch lengths of full-size components and showing details of the following:
 - 1. Joinery, including concealed welds.
 - 2. Anchorage.
 - 3. Expansion provisions.
 - 4. Glazing.
 - 5. Flashing and drainage.
- F. Other Action Submittals:
 - 1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.
- G. Delegated-Design Submittal: For aluminum-framed systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Detail fabrication and assembly of aluminum-framed systems.
 - 2. Include design calculations.
- H. Qualification Data: For qualified Installer and testing agency.
- I. Seismic Qualification Certificates: For aluminum-framed systems, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
- J. Welding certificates.
- K. Preconstruction Test Reports: For sealant.
- L. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems, indicating compliance with performance requirements.
- M. Source quality-control reports.
- N. Quality-Control Program for Structural-Sealant-Glazed System: Include reports.
- O. Field quality-control reports.
- P. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.
- Q. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
- C. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.
- D. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
 - 1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.
- E. Accessible Entrances: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.
- F. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.
- G. Welding Qualifications: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code - Aluminum."

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 WARRANTY

- A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration caused by thermal movements.

- c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - d. Adhesive or cohesive sealant failures.
 - e. Water leakage through fixed glazing and framing areas.
 - f. Failure of operating components.
2. Warranty Period: Two years from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

A. Entrance Door Hardware:

1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.
2. Initial Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Basis-of-Design Product: The design is based on the product named in the basis-of-design and within the Construction Drawings. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified and based on substitution request approval.
- B. See Div 01 Section 012500 for "Substitution Procedures".

2.2 MANUFACTURERS

- A. 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:
- B. Basis-of-Design Product: Kawneer, Trifab VG (Interior entrance) and 451T (Thermal Framing Systems (Exterior Entrance)). and accessories to provide a complete entrance door system.
 1. System dimensions: 2" x 4-1/2".
 2. Glass: Center, Exterior or Interior.
- C. Manufactures: or a comparable product by one of the following:

1. Arcadia Inc.
2. EFCO Corporation.
3. Thermal Windows, Inc.
4. Wausau Window and Wall Systems.
5. WinCo Window Company.

D. Exterior Bi-Fold Doors:

1. Basis-of-Design: Kawneer: 4-panel thermal break aluminum Bi-fold door series AA 3720.
 - a. LaCantina: 4-panel Thermal-Break aluminum bi-fold door.
 - b. Western Window Systems: 4-panel Classic Line Thermal Break aluminum bi-fold door Series 9500 Bi-Fold Door.
 - c. Panoramic Doors: 4-panel Signature Series Thermal break Aluminum Bi-fold door
2. Glass: Center, Exterior or Interior.
3. Finish: Aluminum.
4. Color: Dark Bronze.

2.3 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B 209.
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Structural Profiles: ASTM B 308/B 308M.
5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Color: Dark Bronze

C. Steel Reinforcement: 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.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.4 FRAMING SYSTEMS

A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: Center.

- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with non-staining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, nonbleeding fasteners and accessories compatible with adjacent materials.
 - 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 - 2. Reinforce members as required to receive fastener threads.
 - 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.
- E. Concealed Flashing: Manufacturer's standard corrosion-resistant, non-staining, nonbleeding flashing compatible with adjacent materials.
- F. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.

2.5 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing 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 deeply penetrated and fillet welded or that incorporate concealed tie rods.
 - a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.
 - 2. Door Design: Medium stile; 3-1/2-inch nominal width.
 - a. Accessible Doors: Smooth surfaced for width of door in area within 10 inches above floor or ground plane.
 - 3. Glazing Stops and Gaskets: Manufacturer's standard, snap-on, extruded-aluminum stops and preformed gaskets.
 - a. Provide nonremovable glazing stops on outside of door.

2.6 ENTRANCE DOOR HARDWARE

- A. General:

1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products.
 2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
 3. Opening-Force Requirements:
 - a. Egress Doors: Not more than 15 lbf to release the latch and not more than 30 lbf to set the door in motion and not more than 15 lbf to open the door to its minimum required width.
 - b. Accessible Interior Doors: Not more than 5 lbf to fully open door.
- B. Hardware Sets: Provide Manufactures standard hardware and as specified in this section.
1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color to be selected by the Architect from the manufacturer's full range of options and colors shall match frame color and named manufacturers' products complying with BHMA standard referenced.
- C. Opening-Force Requirements:
1. Latches and Exit Devices: Not more than 15 lbf required to release latch.
- D. Continuous Hinges: BHMA A156.4, Grade 1.
1. Continuous geared hinge with fasteners staggered at approximately 6-inches on center.
 2. Finish: To match color of door frame.
- E. Mortise Auxiliary Locks: BHMA A156.5, Grade 1.
- F. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
- G. Cylinders: As specified in Division 08 Section "Door Hardware."
- H. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.
- I. Operating Trim: BHMA A156.6.
- J. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to meet field conditions and requirements for opening force.
- K. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.
- L. Weather Stripping: Manufacturer's standard replaceable components.

1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
 2. Sliding Type: AAMA 701, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.
- M. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.
- N. Silencers: BHMA A156.16, Grade 1.
- O. Thresholds: BHMA A156.21, raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch. ADA and ICC/ANSI A117.1-2003 compliant.
- P. Finger Guards: Manufacturer's standard collapsible neoprene or PVC gasket anchored to frame hinge-jamb at center-pivoted doors.

2.7 ACCESSORY MATERIALS

- A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 07 Section "Joint Sealants."
- B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil thickness per coat.

2.8 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. Framing Members, General: 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 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 shear-block system and head-and-sill-receptor system with shear blocks at intermediate horizontal members.
- F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
 - 1. At exterior doors, provide compression weather stripping at fixed stops.
 - 2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.
- G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
 - 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.

2.9 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas 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 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.
 - 6. Seal joints watertight unless otherwise indicated.

- B. Metal Protection:
 - 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
 - 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
- D. Set continuous sill members and flashing in full sealant bed as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.
- E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.
- F. 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.
- G. Install perimeter joint sealants as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.

3.3 ERECTION TOLERANCES

- A. Install aluminum-framed systems to comply with the following maximum erection tolerances:
 - 1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.
 - 2. Alignment:
 - a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
 - b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.
- B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch.

3.4 ADJUSTING

- A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.

1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch, measured to the leading door edge.

END OF SECTION 08 4113

SECTION 08 5113 - ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes fixed aluminum-framed windows.
- B. Related Sections:
 - 1. Division 08 Section "Aluminum-Framed Entrances and Storefronts" for entrance and larger window openings.
 - 2. Division 08 Section "Glazing" for glazing to be used per location.

1.2 PERFORMANCE REQUIREMENTS

- A. General: Provide aluminum windows capable of complying with performance requirements indicated, based on testing manufacturer's windows that are representative of those specified, and that are of minimum test size required by AAMA/WDMA 101/I.S.2/NAFS.
- B. Structural Performance: Provide aluminum windows capable of withstanding the effects of the following loads, based on testing units representative of those indicated for Project that pass AAMA/WDMA 101/I.S.2/NAFS, Uniform Load Structural Test:
 - 1. Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed indicated in miles per hour at 33 feet above grade, according to ASCE 7, Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on Drawings.
 - a. Basic Wind Speed 90 mph
 - b. Importance Factor: 1.0.
 - c. Exposure Category: D
 - 2. Deflection: Design glass framing system to limit lateral deflections of glass edges to less than 1/175 of glass-edge length or 3/4 inch whichever is less, at design pressure based on testing performed according to AAMA/WDMA 101/I.S.2/NAFS, Uniform Load Deflection Test or structural computations.
- C. Windborne-Debris Resistance: Provide glazed windows capable of resisting impact from windborne debris, based on the pass/fail criteria as determined from testing glazed windows identical to those specified, according to ASTM E 1886 and testing information in ASTM E 1996 and requirements of authorities having jurisdiction.
- D. 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 (Range): 120 deg F

1.3 SUBMITTALS

- A. Product Data: For each type of aluminum window indicated.
- B. Product Schedule: Use same designations indicated on Drawings.
- C. Maintenance data.

1.4 QUALITY ASSURANCE

- A. Installer: A qualified installer, approved by manufacturer to install manufacturer's products.
- B. Glazing Publications: Comply with published recommendations of glass manufacturers and with GANA's "Glazing Manual" unless more stringent requirements are indicated.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Failure to meet performance requirements.
 - b. Structural failures including excessive deflection, water leakage, air infiltration, or condensation.
 - c. Faulty operation of movable sash and hardware.
 - d. Deterioration of metals, other materials, and metal finishes beyond normal weathering.
 - e. Failure of insulating glass.
 2. Warranty Period:
 - a. Window: 3 (Three) years from date of Substantial Completion.
 - b. Glazing: 10 (ten) years from date of Substantial Completion.
 - c. Metal Finish: 10 (ten) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Kawneer, 8400TL Framing (Thermally Broken) Horizontal Sliding Windows ganged with Kawneer, 8400TL Framing (Thermally Broken) Fixed Upper Transom Window Bases of Design. Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
1. EFCO Corporation.
 2. Kawneer; an Alcoa Company.
 3. Thermal Windows, Inc.
 4. Wausau Window and Wall Systems.
 5. Winco Window Company.
- B. Product:
1. Window Type: Sliding and fixed Upper Transom.
 2. 4-inch frame depth x 2-inch frame height.
 3. Architectural Grade Window F-HC 100/F-AW 100/AW-PG 100-FW
 4. Testing Standard: AAMA / WDMA / CSA 101 / I.S. 2 / A440 (NAFS)
 5. Wall thickness 0.070 Nominal

2.2 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing" for glass units and glazing requirements applicable to glazed aluminum window units.

2.3 MATERIALS

- A. Aluminum Extrusions: Alloy and temper recommended by aluminum window manufacturer for strength, corrosion resistance, and application of required finish and not less than 0.090-inch wall thickness at any location for the main frame and sash members.
- B. Color: Dark Bronze
- C. Thermal Barrier: The thermal barrier shall be Kawneer ISOLOCK with a nominal 3/8-inch separation consisting of a two-par, chemically curing high density polyurethane which is mechanically and adhesively bonded to the aluminum.
- D. Fasteners: Aluminum, nonmagnetic stainless or other materials to be non-corrosive and compatible with aluminum window members, trim, hardware, anchors, and other components.
- E. Anchors, Clips and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand pressure indicated.

- F. Reinforcing Members: Aluminum, nonmagnetic stainless, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.
- G. Sealant: For sealants required fabricated windows, provide window manufacturer's standard, permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint and size and movement.

2.4 FABRICATION

- A. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight and free of defects of deformations.
 - 2. Accurately fit joint; make joints flush, hairline and weatherproof.
 - 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.
 - 7. Fasteners, anchors and connection devices that are concealed from view to greatest extent possible.
- B. Window Frame Joinery: Screw-Spline, Factory sealed frame and vent corner Joints.
- C. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.
- D. Fabricate aluminum windows that are re-glazable without dismantling sash or framing.
- E. Mullions: Provide mullions and cover plates as shown, 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, as indicated. Provide mullions and cover plates capable of withstanding design loads of window units.
- F. Sub frames: Provide sub frames with anchors for window units as shown, of profile and dimensions indicated but not less than 0.093" thick extruded aluminum. Miter or cope corners, and join with concealed mechanical joint fasteners. Finish to match window units. Provide sub frames capable of withstanding design loads of window units.
- G. Factory-Glazed Fabrications: Glaze aluminum windows in the factory where practical and possible for applications indicated. Comply with requirements in Division 08 Section "Glazing" and with AAMA/WDMA/CSA 101/I.S.2/A440 (NAFS).
- H. Glazing Stops: Provide snap-on glazing stops coordinated with Division 08 Section "Glazing" and glazing system indicated. Provide glazing stops to match frame.

2.5 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 INSTALLATION

- A. 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.
- B. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.
- C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
- D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.
- E. Adjust operating sashes and ventilators, screens, hardware, and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.
- F. Clean aluminum surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
- G. Clean factory-glazed glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.
- H. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION 08 5113

SECTION 08 7100 – DOOR HARDWARE

PART 1 - GENERAL (Typically this Section/Schedule of HWS prepared by Hardware Supplier)

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes commercial door hardware for the following:
 - 1. Swinging doors.
 - 2. Sliding doors.
 - 3. Other doors to the extent indicated.
- B. Door hardware includes, but is not necessarily limited to, the following:
 - 1. Mechanical door hardware.
 - 2. Electromechanical door hardware, power supplies, back-ups and surge protection.
 - 3. Automatic operators.
 - 4. Cylinders specified for doors in other sections.
- C. Related Sections:
 - 1. Division 08 Section "Door Hardware Schedule".
 - 2. Division 08 Section "Hollow Metal Doors and Frames".
 - 3. Division 08 Section "Interior Aluminum Doors and Frames".
 - 4. Division 08 Section "Flush Wood Doors".
 - 5. Division 08 Section "Automatic Door Operators".
 - 6. Division 08 Section "Access Control Hardware".
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
 - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 - 2. ICC/IBC - International Building Code.
 - 3. NFPA 80 - Fire Doors and Windows.
 - 4. NFPA 101 - Life Safety Code.
 - 5. NFPA 105 - Installation of Smoke Door Assemblies.
 - 6. UL/ULC and CSA C22.2 – Standards for Automatic Door Operators Used on Fire and Smoke Barrier Doors and Systems of Doors.
 - 7. State Building Codes, Local Amendments.

- E. Standards: All hardware specified herein shall comply with the following industry standards:

1. ANSI/BHMA Certified Product Standards - A156 Series
2. UL10C – Positive Pressure Fire Tests of Door Assemblies

1.3 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.
4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

- C. Shop Drawings: Details of electrified access control hardware indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of

the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

- a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
 - b. Complete (risers, point-to-point) access control system block wiring diagrams.
2. Electrical Coordination: Coordinate with related Division 26 Electrical Sections the voltages and wiring details required at electrically controlled and operated hardware openings.
- D. Keying Schedule: Prepared under the supervision of the Owner, separate schedule detailing final keying instructions for locksets and cylinders in writing. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner to approve submitted keying schedule prior to the ordering of permanent cylinders.
- E. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact information of the manufacturers providing the hardware and their nearest service representatives. The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.
- F. Warranties and Maintenance: Special warranties and maintenance agreements specified in this Section.

1.4 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Installer Qualifications: Installers, trained by the primary product manufacturers, with a minimum 3 years documented experience installing both standard and electrified builders hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor in good standing by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified

Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

1. Scheduling Responsibility: Preparation of door hardware and keying schedules.
- D. Source Limitations: Obtain each type and variety of Door Hardware specified in this Section from a single source, qualified supplier unless otherwise indicated.
1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
 2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.
- E. Regulatory Requirements: Comply with NFPA 70, NFPA 80, NFPA 101 and ANSI A117.1 requirements and guidelines as directed in the model building code including, but not limited to, the following:
1. NFPA 70 "National Electrical Code", including electrical components, devices, and accessories listed and labeled as defined in Article 100 by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 2. Where indicated to comply with accessibility requirements, comply with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," ANSI A117.1 as follows:
 - a. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
 - b. Door Closers: Comply with the following maximum opening-force requirements indicated:
 - 1) Interior Hinged Doors: 5 lbf applied perpendicular to door.
 - 2) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 - c. Thresholds: Not more than 1/2 inch high. Bevel raised thresholds with a slope of not more than 1:2.
 3. NFPA 101: Comply with the following for means of egress doors:
 - a. Latches, Locks, and Exit Devices: Not more than 15 lbf to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.
 - b. Thresholds: Not more than 1/2 inch high.
 4. Fire-Rated Door Assemblies: Provide door hardware for assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency

acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252 (neutral pressure at 40" above sill) or UL-10C.

- a. Test Pressure: Positive pressure labeling.
- F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.
- G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
1. Function of building, purpose of each area and degree of security required.
 2. Plans for existing and future key system expansion.
 3. Requirements for key control storage and software.
 4. Installation of permanent keys, cylinder cores and software.
 5. Address and requirements for delivery of keys.
- H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
 2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
 3. Review sequence of operation narratives for each unique access controlled opening.
 4. Review and finalize construction schedule and verify availability of materials.
 5. Review the required inspecting, testing, commissioning, and demonstration procedures
- I. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.
- C. Door and Frame Preparation: Related Division 08 Sections (Steel, Aluminum and Wood) doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
 - 1. Structural failures including excessive deflection, cracking, or breakage.
 - 2. Faulty operation of the hardware.
 - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 4. Electrical component defects and failures within the systems operation.
- C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

- D. Special Warranty Periods:
 - 1. Seven years for heavy duty cylindrical (bored) locks and latches.
 - 2. Five years for standard duty cylindrical (bored) locks and latches.
 - 3. Five years for exit hardware.
 - 4. Twenty five years for manual surface door closers.
 - 5. Two years for electromechanical door hardware.

1.8 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Continuing Service: Beginning at Substantial Completion, and running concurrent with the specified warranty period, provide continuous (6) months full maintenance including repair and replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door opening operation. Provide parts and supplies as used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.
 - 1. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
 - a. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- B. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

- A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity, unless otherwise indicated:
 - a. Two Hinges: For doors with heights up to 60 inches.
 - b. Three Hinges: For doors with heights 61 to 90 inches.
 - c. Four Hinges: For doors with heights 91 to 120 inches.
 - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
 2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
 - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
 - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
 3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
 - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
 - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
 4. Hinge Options: Comply with the following where indicated in the Hardware Sets or on Drawings:
 - a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the following applications:
 - 1) Out-swinging exterior doors.
 - 2) Out-swinging access controlled doors.
 - 3) Out-swinging lockable doors.
 5. Acceptable Manufacturers:
 - a. Hager Companies (HA).
 - b. McKinney Products (MK).
- B. Continuous Geared Hinges: ANSI/BHMA A156.26 certified continuous geared hinge with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Provide concealed flush mount (with or without inset), full surface, or half surface, in standard and heavy duty models, as specified in the Hardware Sets. Concealed continuous hinges to be U.L. listed for use on up to and including 90 minute rated door installations and U.L. listed for windstorm components where applicable. Factory cut hinges for door size and provide with removable service power transfer panel where indicated at electrified openings.
1. Acceptable Manufacturers:

- a. McKinney Products (MK).
- b. Pemko Manufacturing (PE).

2.3 POWER TRANSFER DEVICES

- A. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Acceptable Manufacturers:

- a. Securitron (SU) - EL-CEPT Series.

- B. Electric Door Hardware Cords: Provide electric transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

1. Acceptable Manufacturers:

- a. McKinney Products (MK) – QC-C Series.

Provide one each of the following tools as part of the base bid contract:

- a. McKinney Products (MK) - Electrical Connecting Kit: QC-R001.
- b. McKinney Products (MK) - Connector Hand Tool: QC-R003.

2.4 DOOR OPERATING TRIM

- A. Door Push Plates and Pulls: ANS/BHMA A156.6 certified door pushes and pulls of type and design specified below or in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.

3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.
 - a. Acceptable Manufacturers:
 - 1) Rockwood Manufacturing (RO).
 - 2) Trimco (TC).

2.5 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
- B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.
 1. Acceptable Manufacturers:
 - a. Corbin Russwin Hardware (RU).
 - b. Sargent Manufacturing (SA).
- C. Cylinders: Original manufacturer cylinders complying with the following:
 1. Mortise Type: Threaded cylinders with rings and straight- or clover-type cam.
 2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
 4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
 5. Keyway: Manufacturer's Standard.
- D. Permanent Cores: Manufacturer's standard; finish face to match lockset; complying with the following:
 1. Removable Cores: Core insert, removable by use of a special key, and for use with only the core manufacturer's cylinder and door hardware. Provide removable core (small or large format) as specified in Hardware Sets.
- E. Keying System: Each type of lock and cylinders to be factory keyed. Conduct specified "Keying Conference" to define and document keying system instructions and requirements. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner. Incorporate decisions made in keying conference, and as follows:
 1. Master Key System: Cylinders are operated by a change key and a master key.

- F. Key Quantity: Provide the following minimum number of keys:
1. Top Master Key: One (1)
 2. Change Keys per Cylinder: Two (2)
 3. Master Keys (per Master Key Group): Two (2)
 4. Construction Keys (where required): Ten (10)
 5. Construction Control Keys (where required): Two (2)
 6. Permanent Control Keys (where required): Two (2)
- G. Construction Keying: Provide construction master keyed cylinders or temporary keyed construction cores where specified. Provide construction master keys in quantity as required by project Contractor. Replace construction cores with permanent cores. Furnish permanent cores for installation as directed under specified "Keying Conference".

2.6 MECHANICAL LOCKS AND LATCHING DEVICES

- A. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Grade 1 certified cylindrical (bored) locksets furnished in the functions as specified in the Hardware Sets. Lock chassis fabricated of heavy gauge steel, zinc dichromate plated, with through-bolted application. Furnish with solid cast levers, standard 2 3/4" backset, and 1/2" (3/4" at rated paired openings) throw brass or stainless steel latchbolt. Locks are to be non-handed and fully field reversible.
1. Acceptable Manufacturers:
 - a. Corbin Russwin Hardware (RU) – CL3300 Series.
 - b. Sargent Manufacturing (SA) – 10 Line.
- B. Cylindrical Locksets, Grade 2 (Standard Duty): ANSI/BHMA A156.2, Series 4000, Grade 2 certified cylindrical (bored) locksets furnished in the functions as specified in the Hardware Sets. Lock chassis fabricated of heavy gauge steel, zinc dichromate plated, with through-bolted application. Furnish with standard 2 3/4" backset and 1/2" throw brass or hardened steel latchbolt. Locks are to be non-handed and fully field reversible.
1. Acceptable Manufacturers:
 - a. Corbin Russwin Hardware (RU) - CL3800 Series.
 - b. Sargent Manufacturing (SA) - 7-Line.
- C. Lock Trim Design: As specified in Hardware Sets.

2.7 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.5.
4. Dustproof Strikes: BHMA A156.16.

2.8 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
 - a. Fire Exit Removable Mullions: Provide keyed removable mullions for use with fire exit devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252. Mullions to be used only with exit devices for which they have been tested.
3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is not acceptable except in any case where the door light extends behind the device as in a full glass configuration.
5. Flush End Caps: Provide heavy weight impact resistant flush end caps made of architectural metal in the same finish as the devices as in the Hardware Sets. Plastic end caps will not be acceptable.

6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty trim with cold forged escutcheons, beveled edges, and four threaded studs for thru-bolts.
 - a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets. Provided free-wheeling type trim where indicated.
 - b. Where function of exit device requires a cylinder, provide an interchangeable core type keyed cylinder (Rim or Mortise) as specified in Hardware Sets.
 7. Vertical Rod Exit Devices: Provide and install interior surface and concealed vertical rod exit devices as Less Bottom Rod (LBR) unless otherwise indicated.
 8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
 9. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
 10. Rail Sizing: Provide exit device rails factory sized for proper door width application.
 11. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.
- B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Mounting rails to be formed from smooth stainless steel, brass or bronze architectural materials no less than 0.072" thick, with push rails a minimum of 0.062" thickness. Painted or aluminum metal rails are not acceptable. Exit device latch to be investment cast stainless steel, pullman type, with deadlock feature.
1. Acceptable Manufacturers:
 - a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
 - b. Sargent Manufacturing (SA) - 80 Series.

2.9 DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:
1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.
 2. Standards: Closers to comply with UL-10C and UBC 7-2 for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
 3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated

frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.

4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
 - a. Where closers are indicated to have mechanical dead-stop, provide heavy duty arms and brackets with an integral positive stop.
 - b. Where closers are indicated to have mechanical hold open, provide heavy duty units with an additional built-in mechanical holder assembly designed to hold open against normal wind and traffic conditions. Holder to be manually selectable to on-off position.
 - c. Where closers are indicated to have a cushion-type stop, provide heavy duty arms and brackets with spring stop mechanism to cushion door when opened to maximum degree.
 - d. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics. Provide drop plates or other accessories as required for proper mounting.
 5. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates, and through-bolt or security type fasteners as specified in the door Hardware Sets.
- B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.
1. Acceptable Manufacturers:
 - a. Sargent Manufacturing (SA) - 351 Series.
 - b. Norton Door Controls (NO) - 7500 Series.
- C. Door Closers, Surface Mounted (Commercial Duty): ANSI/BHMA 156.4, Grade 1 certified surface mounted, institutional grade door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck, closing sweep, and latch speed control valves. Provide non-handed units standard.
1. Acceptable Manufacturers:
 - a. Norton Door Controls (NO) - 8500 Series.
 - b. Sargent Manufacturing (SA) - 1431 Series.
- D. Door Closers, Surface Mounted (Utility Grade): ANSI/BHMA 156.4, Grade 1 certified surface mounted, utility grade door closers with complete spring power adjustment, sizes 1 thru 6. Closers to be rack and pinion type, cast aluminum case construction, with

adjustable backcheck, closing sweep, and latch speed control valves. Provide closer standard packed for regular, top-jamb, and parallel arm type mounting applications.

1. Acceptable Manufacturers:
 - a. Norton Door Controls (NO) - 1601 Series.
 - b. Sargent Manufacturing (SA) - 1131 Series.

2.10 AUTOMATIC DOOR OPERATORS

- A. General: Provide operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for compliance with UL 325. Coordinate operator mechanisms with door operation, hinges, and activation devices.
 1. Fire-Rated Doors: Provide door operators for fire-rated door assemblies that comply with NFPA 80 for fire-rated door components and are listed and labeled by a qualified testing agency.
- B. Electrohydraulic Door Operators: Self-contained low-pressure units with rack and pinion design contained within a cast aluminum housing. Door closing speed controlled by independent hydraulic adjustment valves in the sweep and latch range of the closing cycle. Operator is to provide conventional door closer opening and closing forces unless the power operator motor is activated. Unit is to include an adjustable hydraulic backcheck valve to cushion the door speed if opened violently. Non-handed units for both push and pull side applications.
- C. Brackets and Reinforcements: Manufacturer's standard, fabricated from aluminum with nonferrous shims for aligning system components.
- D. Standard: Certified ANSI/BHMA A156.19.
 1. Performance Requirements:
 - a. Opening Force if Power Fails: Not more than 15 lbf required to release a latch if provided, not more than 30 lbf required to manually set door in motion, and not more than 15 lbf required to fully open door.
 - b. Entrapment Protection: Not more than 15 lbf required to prevent stopped door from closing or opening.
- E. Configuration: Surface mounted. Door operators to control single swinging and pair of swinging doors.
- F. Operation: Power opening and spring closing operation capable of meeting ANSI A117.1 accessibility guideline. Provide time delay for door to remain open before initiating closing cycle as required by ANSI/BHMA A156.19. When not in automatic mode, door operator to function as manual door closer with fully adjustable opening and closing forces, with or without electrical power.
 1. On-off switch to control power to be key switch operated.

- G. Features: Operator units to have full feature adjustments for door opening and closing force and speed, backcheck, motor assist acceleration from 0 to 30 seconds, time delay, vestibule interface delay, obstruction recycle, and hold open time from 0 up to 30 seconds.
- H. Provide outputs and relays on board the operator to allow for coordination of exit device latch retraction, electric strikes, magnetic locks, card readers, safety and motion sensors and specified auxiliary contacts.
- I. Activation Devices: Provide activation devices in accordance with ANSI/BHMA A156.19 standard, for condition of exposure indicated and for long term, maintenance free operation under normal traffic load operation. Coordinate activation control with electrified hardware and access control interfaces. Activation switches are standard SPST, with optional DPDT availability.
- J. Signage: As required by cited ANSI/BHMA A156.19 standard for the type of operator.
 - 1. Acceptable Manufacturers:
 - a. Norton Door Controls (NO) - 6000 Series.

2.11 ARCHITECTURAL TRIM

A. Door Protective Trim

- 1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
- 2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
- 3. Metal Protection Plates: ANSI/BHMA A156.6 certified metal protection plates (kick, armor, or mop), beveled on four edges (B4E), fabricated from the following:
 - a. Stainless Steel: 300 series, .050-inch thick, with countersunk screw holes (CSK).
- 4. Fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets.
- 5. Metal Door Edging: Door protection edging fabricated from a minimum .050-inch thick metal sheet, formed into an angle or "U" cap shapes, surface or mortised mounted onto edge of door. Provide appropriate leg overlap to account for protection plates as required. Height to be as specified in the Hardware Sets.
- 6. Acceptable Manufacturers:
 - a. Rockwood Manufacturing (RO).

- b. Trimco (TC).

2.12 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
 - 1. Acceptable Manufacturers:
 - a. Rockwood Manufacturing (RO).
 - b. Trimco (TC).
- C. Overhead Door Stops and Holders: ANSI/BHMA A156.6, Grade 1 certified overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.
 - 1. Acceptable Manufacturers:
 - a. Rixson Door Controls (RF).
 - b. Rockwood Manufacturing (RO).

2.13 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
 - 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.
- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and UBC 7-2, Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated, based on testing according to ASTM E 1408.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Acceptable Manufacturers:
 1. Pemko Manufacturing (PE).
 2. Zero International (ZE).

2.14 ELECTRONIC ACCESSORIES

- A. Power Supplies: Provide Nationally Recognized Testing Laboratory Listed 12VDC or 24VDC (field selectable) filtered and regulated power supplies. Include battery backup option with integral battery charging capability in addition to operating the DC load in event of line voltage failure. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.
 1. Acceptable Manufacturers:
 - a. Corbin Russwin Hardware (RU) – 782.
 - b. Sargent Manufacturing (SA) – 3500 Series.
 - c. Securitron (SU) - BPS Series.

2.15 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.16 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.

- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
 - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
 - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
 - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate

removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

- D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish, and provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SCHEDULE

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

B. Manufacturer's Abbreviations:

1. IVE - Ives
2. FAL - Falcon
3. SCH - Schlage
4. VON – Von Duprin
5. ZER - Zero
6. GLY – Glen Johnson
7. PEM - Pemko

Hardware Schedule:

⚡ = Hardware Item Requiring Electrical Coordination

HARDWARE GROUP NO. 01

Door Number(s): 107D, 107E

EACH TO HAVE:

1 SET	EXTERIOR HINGE(S)	5BB1HW SERIES	630	IVE
1 EA	PANIC HARDWARE	25-R-NL ("F" @ RATED)	626	FAL
1 SET	PERMANENT CORE(S)	23-030 CKC EV29T	626	SCH
1 SET	FSIC HOUSING(S)	AS REQUIRED BY LOCKING HARDWARE	626	SCH
1 EA	SURFACE CLOSER	4050 RW/PA TBWMS	689	LCN
1 EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1 EA	WALL STOP	WS443	626	IVE
1 EA	PERIMETER GASKET	429 SERIES (1 @ HEAD, 2 @ JAMB)	628	ZER
1 EA	DOOR SWEEP	39 SERIES	719	ZER
1 EA	THRESHOLD	656 SERIES X 223	719	ZER
1 SET	ACCESS CONTROL EQUIPMENT	BY DIVISION 28		⚡
1 EA	CARD READER	BY DIVISION 28		⚡
1 EA	DOOR POSITION SWITCH	BY DIVISION 28		⚡
1 EA	MOTION SENSOR	BY DIVISION 28		⚡
1 SET	LOW VOLTAGE POWER	BY DIVISION 28		⚡
1 SET	RACEWAY & CONDUIT	BY DIVISION 26		⚡
1 SET	LV WIRE & TERMINATIONS	BY DIVISION 28		⚡
1 SET	WIRING DIAGRAMS	PER 087100 ARTICLE "SUBMITTALS"		⚡

OPERATIONAL DESCRIPTION

1. ACCESS CONTROL SYSTEM MONITORS DOOR POSITION AND REQUEST TO EGRESS.

HARDWARE GROUP NO. 02

Door Number(s): 116C, 122A

EACH TO HAVE:

1 SET	INTERIOR HINGE(S)	5BB1HW SERIES	652	IVE
1 EA	PANIC HARDWARE	98-L-BE-06 ("F" @ RATED)	626	VON
1 SET	PERMANENT CORE(S)	23-030 CKC EV29T	626	SCH
1 SET	FSIC HOUSING(S)	AS REQUIRED BY LOCKING HARDWARE	626	SCH
1 EA	SURFACE CLOSER	4050 RW/PA TBWMS	689	LCN
1 EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1 EA	WALL STOP	WS406/407CCV	630	IVE
1 SET	PERMITER GASKET	488S PSA SERIES (HEAD AND JAMBS)	BLK	ZER

HARDWARE GROUP NO. 03

Door Number(s): 108A, 108B

EACH TO HAVE:

1 SET	INTERIOR HINGE(S)	5BB1HW SERIES	652	IVE
1 EA	KEY PAD LOCK	CO-200-CY-70-KP-RHO-JD	626	SCE
1 SET	PERMANENT CORE(S)	23-030 CKC EV29T	626	SCH
1 EA	SURFACE CLOSER	4050 RW/PA TBWMS	689	LCN
1 EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1 EA	WALL STOP	WS406/407CCV	630	IVE
DOOR HARDWARE			08 7100 - 22	

SET	PERMITER GASKET	488S PSA SERIES (HEAD AND JAMBS)	BLK	ZER
-----	-----------------	----------------------------------	-----	-----

HARDWARE GROUP NO. 04

Door Number(s): 102A, 103A, 104A, 106A, 130A

EACH TO HAVE:

1 SET	INTERIOR HINGE(S)	5BB1 SERIES (HW AS REQ'D)	652	IVE
1 EA	STOREROOM LOCK	T581J DANE	626	FAL
1 SET	PERMANENT CORE(S)	23-030 CKC EV29T	626	SCH
1 EA	SURFACE CLOSER	4050 RW/PA TBWMS	689	LCN
1 EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1 EA	WALL STOP	WS406/407CCV	630	IVE
1 EA	THRESHOLD	654 SERIES X 223	719	ZER
1 SET	SILENCERS / GASKET	BY FRAME MANUFACTURER		

HARDWARE GROUP NO. 05

Door Number(s): 118A, 119A, 120A, 123A, 124A, 125A, 126A, 127A

EACH TO HAVE:

1 SET	INTERIOR HINGE(S)	5BB1 SERIES (HW AS REQ'D)	652	IVE
1 EA	ENTRY LOCK	T501J DANE	626	FAL
1 SET	PERMANENT CORE(S)	23-030 CKC EV29T	626	SCH
1 EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1 EA	WALL STOP	WS406/407CCV	630	IVE
1 SET	PERMITER GASKET	488S PSA SERIES (HEAD AND JAMBS)	BLK	ZER
1 EA	DOOR SWEEP	253 / 153 SERIES	719	ZER
1 EA	SURFACE CLOSURE	4050 RW/PA TBWMS	689	LCN

HARDWARE GROUP NO. 06

Door Number(s): 123A, 129A

EACH TO HAVE:

1 SET	INTERIOR HINGE(S)	5BB1 SERIES (HW AS REQ'D)	652	IVE
1 EA	ENTRY LOCK	T501J DANE	626	FAL
1 SET	PERMANENT CORE(S)	23-030 CKC EV29T	626	SCH
1 EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1 EA	WALL STOP	WS406/407CCV	630	IVE
1 SET	SILENCERS / GASKET	BY FRAME MANUFACTURER	689	LCN
1 EA	SURFACE CLOSURE	4050 RW/PA TBWMS		

HARDWARE GROUP NO. 07

Door Number(s): 105A

EACH TO HAVE:

1 SET	INTERIOR HINGE(S)	5BB1 SERIES (HW AS REQ'D)	652	IVE
1 EA	PRIVACY LOCK	MA321 OCCUPIED/VACANT DGM	626	FAL
1 EA	OVERHEAD STOP	90S SERIES	630	GLY
1 EA	SURFACE CLOSER	4050 RW/PA TBWMS	689	LCN
1 EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1 SET	PERMITER GASKET	488S PSA SERIES (HEAD AND JAMBS)	BLK	ZER
1 EA	DOOR SWEEP	253 / 153 SERIES	719	ZER
DOOR HARDWARE			08 7100 - 23	

1 EA	THRESHOLD	654 SERIES X 223	719	ZER
------	-----------	------------------	-----	-----

HARDWARE GROUP NO. 08

Door Number(s): 113A, 114A, 115A

EACH TO HAVE:

1 SET	INTERIOR HINGE(S)	5BB1 SERIES (HW AS REQ'D)	652	IVE
1 EA	PRIVACY LOCK	MA321 OCCUPIED/VACANT DGM	626	FAL
1 EA	SURFACE CLOSER	4050 RW/PA TBWMS	689	LCN
1 EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1 EA	WALL STOP	WS406/407CCV	630	IVE
1 SET	PERMITER GASKET	488S PSA SERIES (HEAD AND JAMBS)	BLK	ZER

HARDWARE GROUP NO. 09

Door Number(s): 121A

EACH TO HAVE:

1 SET	INTERIOR HINGE(S)	5BB1 SERIES (HW AS REQ'D)	652	IVE
1 EA	PRIVACY LOCK	MA321 OCCUPIED/VACANT DGM	626	FAL
1 EA	OVERHEAD STOP	90S SERIES	630	GLY
1 EA	SURFACE CLOSER	4050 RW/PA TBWMS	689	LCN
1 EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1 SET	PERMITER GASKET	488S PSA SERIES (HEAD AND JAMBS)	BLK	ZER

HARDWARE GROUP NO. 10

Door Number(s): 116A, 116B

EACH TO HAVE:

1 SET	INTERIOR HINGE(S)	5BB1 SERIES (HW AS REQ'D)	652	IVE
1 EA	PASSAGE SET	T101S DANE	626	FAL
1 EA	SURFACE CLOSER	4050 RW/PA TBWMS	689	LCN
1 EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1 EA	WALL STOP	WS406/407CCV	630	IVE
1 SET	SILENCERS / GASKET	BY FRAME MANUFACTURER		

HARDWARE GROUP NO. 11

Door Number(s): 112A

EACH TO HAVE:

1 SET	INTERIOR HINGE(S)	5BB1 SERIES (HW AS REQ'D)	652	IVE
1 EA	PASSAGE SET	T101S DANE	626	FAL
1 EA	OVERHEAD STOP	90S SERIES	630	GLY
1 EA	SURFACE CLOSER	4050 RW/PA TBWMS	689	LCN
1 EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1 SET	SILENCERS / GASKET	BY FRAME MANUFACTURER		

HARDWARE GROUP NO. 12

Door Number(s): 110A

EACH TO HAVE:

1 SET	INTERIOR HINGE(S)	5BB1 SERIES (HW AS REQ'D)	652	IVE
1 EA	PASSAGE SET	T101S DANE	626	FAL
1 EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1 EA	WALL STOP	WS406/407CCV	630	IVE
1 SET	SILENCERS / GASKET	BY FRAME MANUFACTURER		
1 EA	SURFACE CLOSURE	4050 SCUSH TBWMS	289	LEM

HARDWARE GROUP NO. 13

Door Number(s): 111A

EACH TO HAVE:

ACTIVE LEAF:

1 SET	INTERIOR HINGE(S)	5BB1HW SERIES	652	IVE
1 SET	PERIMETER GASKET	488S PSA SERIES (HEAD AND JAMB)	BLK	ZER
1 SET	STOREROOM LOCK	T581J DANE	626	FAL
1 EA	SURFACE CLOSER	4050 RW/PA TBWMS	689	LCN
1 EA	WALL STOP	WS406/407CCV	630	IVE
1 SET	HINGE(S)	5BB1 HW SERIES	652	IVE

INACTIVE LEAF:

1 SET	FLUSH BOLT	283D		IVE
3 SET	HINGE(S)	5BB1 HW SERIES	652	IVE
1 EA	ASTRAGAL	357D		PEM
1 EA	SURFACE CLOSURE	4050 SCUSH TBWMS	289	LEM
1 EA	WALL STOP	WS406/407CCV	630	IVE

HARDWARE GROUP NO. 14

DOOR NUMBER(S): 101A

EACH TO HAVE:

1 SET	INTERIOR HINGE(S)	5BB1 SERIES (HW AS REQ'D)	652	IVE
1 EA	STOREROOM LOCK	T581J DANE	626	FAL
1 SET	PERMANENT CORE(S)	23-030 CKC EV29T	626	SCH
1 EA	SURFACE CLOSER	4050 RW/PA TBWMS	689	LCN
1 EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1 EA	WALL STOP	WS406/407CCV	630	IVE
1EA	THRESHOLD	654 SERIES X 223	630	ZER
1EA	PANIC HARDWARE	25-R-NL ("F" @ RATED)	626	FAL
1 SET	SILENCERS / GASKET	BY FRAME MANUFACTURER		

⚡ = Hardware Item Requiring Electrical Coordination

HARDWARE GROUP NO. AL-01

Door Number(s): 128B

EACH TO HAVE:

DOOR HARDWARE

08 7100 - 25

1 EA	CONTINUOUS HINGE	112HD EPT		628	IVE
1 EA	POWER TRANSFER	EPT10	↗	689	VON
1 EA	PANIC HARDWARE	RX-QEL-3549/9849-EO	↗	626	VON
1 EA	PANIC HARDWARE	RX-QEL-3549/9849-NL-OP	↗	626	VON
1 SET	PERMANENT CORE(S)	23-030 CKC EV29T		626	SCH
1 SET	FSIC HOUSING(S)	AS REQUIRED BY LOCKING HARDWARE		626	SCH
1 EA	OFFSET DOOR PULL	8190EZHD 10" STD		630	IVE
1 EA	OVERHEAD STOP	100S ADJ SERIES		630	GLY
1 EA	SURFACE CLOSER	4050 RW/PA TBWMS		689	LCN
1 EA	AUTOMATIC OPERATOR	4642 TBWMS	√	689	LCN
2 EA	ADO ACTUATOR	8310-8181T	√	630	LCN
1 SET	CLOSER BRACKET(S)	AS REQUIRED TO INSTALL CLOSER		689	LCN
1 SET	PERIMETER GASKET	BY DOOR ASSEMBLY MANUFACTURER			
1 SET	MEETING STILE GASKET	BY DOOR ASSEMBLY MANUFACTURER			
1 EA	DOOR SWEEP	BY DOOR ASSEMBLY MANUFACTURER			
1 EA	THRESHOLD	BY DOOR ASSEMBLY MANUFACTURER			
1 SET	ACCESS CONTROL EQUIPMENT	BY DIVISION 28	↗		
1 EA	CARD READER	BY DIVISION 28	↗		
1 EA	DOOR POSITION SWITCH	BY DIVISION 28	↗		
1 SET	120VAC POWER	BY DIVISION 26	↗		
1 SET	LOW VOLTAGE POWER	BY DIVISION 28	↗		
1 SET	REMOTE RELEASE HDWR	BY DIVISION 28	↗		
1 SET	MV WIRE & TERMINATIONS	BY DIVISION 26	↗		
1 SET	RACEWAY & CONDUIT	BY DIVISION 26	↗		
1 SET	LV WIRE & TERMINATIONS	BY DIVISION 28	↗		
1 SET	WIRING DIAGRAMS	PER 087100 ARTICLE "SUBMITTALS"	↗		

OPERATIONAL DESCRIPTION

1. DOOR IS NORMALLY CLOSED, LATCHED, AND SECURE AGAINST UNAUTHORIZED ENTRANCE.
2. VALID CREDENTIAL AT READER MOMENTARILY RETRACTS BOTH LATCHES TO ALLOW ENTRANCE.
3. SIGNAL FROM REMOTE RELEASE SYSTEM MOMENTARILY RETRACTS BOTH LATCHES TO ALLOW ENTRANCE.
4. INSIDE PANIC HARDWARE ALWAYS ALLOWS IMMEDIATE EGRESS.
5. ACCESS CONTROL SYSTEM MONITORS DOOR POSITION AND REQUEST TO EGRESS.
6. OUTSIDE ACTUATOR IS DISABLED EXCEPT WHEN LATCHES ARE ELECTRONICALLY RETRACTED. INSIDE ACTUATOR IS ALWAYS ENABLED. DEPRESSING ENABLED ACTUATOR RETRACTS ACTIVE LEAF LATCH (IF EXTENDED) AND THEN OPENS DOOR.

↗ = Hardware Item Requiring Electrical Coordination

HARDWARE GROUP NO. AL-02

Door Number(s): 109A, 117A

EACH TO HAVE:

1 EA	CONTINUOUS HINGE	112HD		628	IVE
1 EA	PANIC HARDWARE	LD-98-NL-OP		626	VON
1 SET	PERMANENT CORE(S)	23-030 CKC EV29T		626	SCH
1 SET	FSIC HOUSING(S)	AS REQUIRED BY LOCKING HARDWARE		626	SCH
1 EA	ELECTRIC STRIKE	6300 FSE	↗	630	VON
1 EA	OFFSET DOOR PULL	8190EZHD 10" STD		630	IVE
1 EA	SURFACE CLOSER	4050 RW/PA TBWMS		689	LCN
1 SET	CLOSER BRACKET(S)	AS REQUIRED TO INSTALL CLOSER		689	LCN

DOOR HARDWARE

08 7100 - 26

1 EA	WALL STOP	WS406/407CCV	630	IVE
1 SET	PERIMETER GASKET	BY DOOR ASSEMBLY MANUFACTURER		
1 EA	DOOR SWEEP	BY DOOR ASSEMBLY MANUFACTURER		
1 EA	THRESHOLD	BY DOOR ASSEMBLY MANUFACTURER		
1 SET	ACCESS CONTROL EQUIPMENT	BY DIVISION 28	↗	
1 EA	CARD READER	BY DIVISION 28	↗	
1 EA	DOOR POSITION SWITCH	BY DIVISION 28	↗	
1 EA	MOTION SENSOR	BY DIVISION 28	↗	
1 SET	LOW VOLTAGE POWER	BY DIVISION 28	↗	
1 SET	RACEWAY & CONDUIT	BY DIVISION 26	↗	
1 SET	LV WIRE & TERMINATIONS	BY DIVISION 28	↗	
1 SET	WIRING DIAGRAMS	PER 087100 ARTICLE "SUBMITTALS"	↗	

OPERATIONAL DESCRIPTION

7. DOOR IS NORMALLY CLOSED, LATCHED, AND SECURE AGAINST UNAUTHORIZED ENTRANCE.
8. VALID CREDENTIAL AT READER MOMENTARILY RELEASES STRIKE TO ALLOW ENTRANCE.
9. INSIDE PANIC HARDWARE ALWAYS ALLOWS IMMEDIATE EGRESS.
10. ACCESS CONTROL SYSTEM MONITORS DOOR POSITION AND REQUEST TO EGRESS.

↗ = Hardware Item Requiring Electrical Coordination

HARDWARE GROUP NO. AL-03

Door Number(s): 128A

EACH TO HAVE:

1 EA	CONTINUOUS HINGE	112HD	628	IVE
1 EA	DUMMY PUSH BAR	250 SERIES	626	FAL
1 EA	OFFSET DOOR PULL	8190EZHD 10" STD	630-316	IVE
1 EA	OVERHEAD STOP	100S ADJ SERIES	630	GLY
1 EA	SURFACE CLOSER	4050 RW/PA TBWMS	689	LCN
1 EA	AUTOMATIC OPERATOR	4642 TBWMS	↗ 689	LCN
1 EA	ADO ACTUATOR	8310-853T (SQUARE)	↗ 630	LCN
1 SET	CLOSER BRACKET(S)	AS REQUIRED TO INSTALL CLOSER	689	LCN
1 SET	PERIMETER GASKET	BY DOOR ASSEMBLY MANUFACTURER		
1 SET	MEETING STILE GASKET	BY DOOR ASSEMBLY MANUFACTURER		
1 EA	DOOR SWEEP	BY DOOR ASSEMBLY MANUFACTURER		
1 EA	THRESHOLD	BY DOOR ASSEMBLY MANUFACTURER		
1 SET	120VAC POWER	BY DIVISION 26	↗	
1 SET	MV WIRE & TERMINATIONS	BY DIVISION 26	↗	
1 SET	RACEWAY & CONDUIT	BY DIVISION 26	↗	
1 SET	WIRING DIAGRAMS	PER 087100 ARTICLE "SUBMITTALS"	↗	

OPERATIONAL DESCRIPTION

11. BOTH ACTUATORS ARE ALWAYS ENABLED. DEPRESSING ENABLED ACTUATOR OPENS DOOR.
12. EXTERIOR ADO ACTUATOR SHALL BE PEDESTAL MOUNTED IN LOCATION SHOWN ON THE FLOOR PLAN. PEDESTAL, MODEL 916-605-C-52 BY CAREPRODX.COM OR EQUAL, SHALL BE 54-INCH X 6-INCH SQUARE BOLLARD WITH PUSH PLATE ACTUATOR SPECIFIED ABOVE. POWDER COAT FINISH AND INTERNAL MOUNTING BASE. COLOR SHALL BE CLEAR SILVER. TOPPED WITH A BLACK ACRYLIC CAP.
13. INTERIOR ADO ACTUATOR SHALL BE WALL MOUNTED. SEE DETAIL 1 ON SHEET G008 FOR MOUNTING HEIGHT ABOVE FINISH FLOOR.
14. INSTALL CARD READER ON PEDESTAL INDICATED IN ITEM #12.

HARDWARE GROUP NO. MFR-01

Door Number(s): 107A, 107B, 107C, 107F, 107G, 107H, 116D, 116E

EACH TO HAVE:

1 SET ALL HARDWARE

BY DOOR ASSEMBLY MANUFACTURER

END OF SECTION 08 7100

SECTION 08 8000 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Glazing Schedule: Review the window elevations with the glazing schedule and provide glazing of the type and locations identified on the elevations meeting the requirements identified in this section.

1.2 SUMMARY

- A. This Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Aluminum storefront and windows.
 - 2. Hollow metal frames.
- B. Related Sections include the following:
 - 1. Division 8 Section "Aluminum Entrances and Storefronts."
 - 2. Division 8 Section "Flush Wood Doors."
 - 3. Division 8 Section "Hollow Metal Doors and Frames."

1.3 DEFINITIONS

- A. Manufacturers of Glass Products: 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 C 1036.
- C. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.
- D. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.
- E. Deterioration of Insulating Glass: Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for 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.

- F. Deterioration of Laminated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:
 - 1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:
 - a. Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed indicated in miles per hour at 33 feet above grade, according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on Drawings.
 - 1) Basic Wind Speed: 90 mph.
 - 2) Importance Factor: II.
 - 3) Exposure Category: B.
 - b. Specified Design Snow Loads: 30 psf, but not less than snow loads applicable to Project as required by ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 7.0, "Snow Loads."
 - c. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action.
 - 1) Load Duration: 60 seconds or less.
 - d. Probability of Breakage for Sloped Glazing: 1 lite per 1000 for lites set more than 15 degrees off vertical and under wind and snow action.
 - 1) Load Duration: 30 days.
 - e. Maximum Lateral Deflection: For the following types of glass supported on all 4 edges, provide thickness required that limits center deflection at

design wind pressure to 1/50 times the short side length or 1 inch, whichever is less.

- 1) For monolithic-glass lites heat treated to resist wind loads.
- 2) For insulating glass.
- 3) For laminated-glass lites.

- f. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.
- g. Thickness of Tinted and Heat-Absorbing Glass: Provide the same thickness for each tint color indicated throughout Project.

- C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6.0 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 with lites 6.0 mm thick and a nominal 1/2-inch-wide interspace.
4. Center-of-Glass Values: Based on using LBL-44789 WINDOW 5.0 computer program for the following methodologies:
 - a. U-Factors: NFRC 100 expressed as Btu/ sq. ft. x h x deg F.
 - b. Solar Heat Gain Coefficient: NFRC 200.
 - c. Solar Optical Properties: NFRC 300.

1.5 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Samples: For the following products, in the form of 12-inch-square Samples for glass.
1. Coated vision glass.
 2. Each type of laminated glass with colored interlayer.
 3. Insulating glass for each designation indicated.
- C. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.
- D. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.

- E. Qualification Data: For installers.
- F. Product Test Reports: For each of the following types of glazing products:
 - 1. Coated float glass.
 - 2. Insulating glass.
 - 3. Glazing gaskets.
- G. Warranties: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association Glazier Certification Program as Level 2 (Senior Glaziers) or Level 3 (Master Glaziers).
- B. Source Limitations for Glass: Obtain the following through one source from a single manufacturer for each glass type: clear float glass, coated float glass, laminated glass and insulating glass.
- C. Source Limitations for Glass Sputter-Coated with Solar-Control Low-E Coatings: Where solar-control low-e coatings of a primary glass manufacturer that has established a certified fabricator program is specified, obtain sputter-coated solar-control low-e-coated glass in fabricated units from a manufacturer that is certified by coated-glass manufacturer.
- D. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.
- E. Glass Product Testing: Obtain glass test results for product test reports in "Submittals" Article from a qualified testing agency based on testing glass products.
 - 1. Glass Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.
- F. Glazing for Fire-Rated Door Assemblies: Glazing for assemblies that comply with NFPA 80 and that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252.
- G. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201 and, for wired glass, ANSI Z97.1.
 - 1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council or another certification agency or manufacturer acceptable to authorities having jurisdiction.

2. Where glazing units, including Kind FT glass and laminated glass, are specified in Part 2 articles for glazing lites more than 9 sq. ft. in exposed surface area of one side, provide glazing products that comply with Category II materials, for lites 9 sq. ft. or less in exposed surface area of one side, provide glazing products that comply with Category I or II materials, except for hazardous locations where Category II materials are required by 16 CFR 1201 and regulations of authorities having jurisdiction.
- H. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
1. GANA Publications: GANA Laminated Division's "Laminated Glass Design Guide" and GANA's "Glazing Manual."
 2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."
 3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Sloped Glazing Guidelines."
 4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units."
- I. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following testing and inspecting agency:
1. Insulating Glass Certification Council.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
 - B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.
- 1.8 PROJECT 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.
- 1.9 WARRANTY
- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form, made out to Owner and signed by coated-glass manufacturer agreeing to replace coated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form, made out to Owner and signed by laminated-glass manufacturer agreeing to replace laminated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 1. Warranty Period: Five years from date of Substantial Completion.
- C. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form, made out to Owner and signed by insulating-glass manufacturer agreeing to replace insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.

2.2 GLASS PRODUCTS

- A. Annealed Float Glass: ASTM C 1036, Type I (transparent flat glass), Quality-Q3; of class indicated.
- B. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent flat glass); Quality-Q3; of class, kind, and condition indicated.
 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.
 2. Provide Kind HS (heat-strengthened) float glass in place of annealed float glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
 3. For uncoated glass, comply with requirements for Condition A.
 4. For coated vision glass, comply with requirements for Condition C (other uncoated glass).
 5. Provide Kind FT (fully tempered) float glass in place of annealed or Kind HS (heat-strengthened) float glass where safety glass is indicated.
- C. Ceramic-Coated Spandrel Glass: ASTM C 1048, Condition B (spandrel glass, one surface ceramic coated), Type I (transparent flat glass), Quality-Q3, and complying with other requirements specified.

1. Fallout Resistance: Provide spandrel units identical to those passing the fallout-resistance test for spandrel glass specified in ASTM C 1048.
- D. Sputter-Coated Float Glass: ASTM C 1376, float glass with metallic-oxide or -nitride coating deposited by vacuum deposition process after manufacture and heat treatment (if any), and complying with other requirements specified.
- E. Wired Glass: ASTM C 1036, Type II (patterned and wired flat glass), Class 1 (clear), Quality-Q-6; and of form and mesh pattern specified.
- F. Insulating-Glass Units, General: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units and with requirements specified in this Article and in Part 2 "Insulating-Glass Units" Article.
 1. Provide Kind HS (heat-strengthened) float glass in place of annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
 2. Provide Kind FT (fully tempered) glass lites where safety glass is indicated.
 3. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.
 4. Sealing System: Dual seal, with primary and secondary sealants as follows:
 - a. Manufacturer's standard sealants.
 5. Spacer Specifications: Manufacturer's standard spacer material and construction.

2.3 GLAZING GASKETS

- A. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned gaskets of material indicated below; complying with ASTM C 509, Type II, black; and of profile and hardness required to maintain watertight seal:
 1. EPDM.

2.4 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; non-staining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
 1. 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; packaged on rolls with release liner protecting adhesive; and complying with AAMA 800 for the following types:
 - 1. Type 1, for glazing applications in which tape acts as the primary sealant.

2.5 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, 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: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

2.6 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to glaze 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.

2.7 MONOLITHIC FLOAT-GLASS UNITS

- A. Uncoated Clear Float-Glass Units: Class 1 ultra-clear (low-iron) float glass and annealed or Kind HS (heat-strengthened) float glass where heat strengthening is required to resist thermal stresses induced by differential shading of individual glass lites and to comply with system performance requirements. Kind HS (heat-strengthened) float glass and Kind FT (fully tempered) float glass.
 - 1. Thickness: 6.0 mm.
 - 2. Self-Cleaning, Low-Maintenance Coating: Pyrolytic coating on first surface.
- B. Coated Clear Float-Glass Units: Class 1 (clear) ultra-clear (low-iron) float glass and annealed or Kind HS (heat-strengthened) float glass where heat strengthening is required to resist thermal stresses induced by differential shading of individual glass lites and to comply with system performance requirements. Kind HS (heat-strengthened) float glass and Kind FT (fully tempered) float glass.

1. Basis-of-Design product: Guardian SN68 or subject to compliance with requirements available products:
 - a. PPG Solarban 60.
 - b. Viracon VE-1-2M.
 - c. AFG Ti-AC 40.
2. Thickness: 6.0 mm.
3. Reflective Coating: Sputtered.
 - a. Color: Clear.
 - b. Location: Second surface.
4. Visible Light Transmittance: 69 percent minimum.
5. Winter Nighttime U-Factor: 0.29 maximum.
6. Summer Daytime U-Factor: 0.29 maximum.
7. Solar Heat Gain Coefficient: 0.37 maximum.
8. Outdoor Visible Reflectance: 12 percent maximum.

2.8 MONOLITHIC WIRED-GLASS UNITS

- A. Polished Wired-Glass Units: Form 1 (wired glass, polished both sides), Quality-Q6, Mesh 2 (M2) (Square), 6.0 mm thick.
 1. Available Manufacturers:
 - a. Asahi/AMA Glass Corp.; affiliated with AFG Industries, Inc.
 - b. Central Glass Co., Ltd.; distributed by Northwestern Industries Inc.
 - c. Pilkington Sales (North America) Ltd.

2.9 INSULATING-GLASS UNITS

- A. Low-E Insulating-Glass Units, Typical Exterior Glazing:
 1. Basis-of-Design product: Guardian SN68 or subject to compliance with requirements available Products:
 - a. PPG; "Solarban 60".
 - b. Viracon; "VE-1-2M".
 - c. AFG Glass; "Ti-AC 40".
 2. Overall Unit Thickness and Thickness of Each Lite: 25 and 6.0 mm.
 3. Interspace Content: Air.
 4. Outdoor Lite: Class 1 (clear).
 - a. Annealed, or FT (fully tempered).
 5. Indoor Lite: Class 1 ultra-clear (low-iron) float glass.
 - a. Annealed, or FT (fully tempered).

6. Low-E Coating: Sputtered on second surface.
 7. Visible Light Transmittance: 69 percent minimum.
 8. Winter Nighttime U-Factor: 0.29 maximum.
 9. Summer Daytime U-Factor: 0.29 maximum.
 10. Solar Heat Gain Coefficient: 0.37 maximum.
- B. Outdoor Visible Reflectance: 12 percent maximum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing glazing, 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 system.
 3. Minimum required face or 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.

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. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.
- 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 sealant-substrate 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 as follows:
 - 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 according to requirements in referenced glazing publications.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- J. Coordinate skylight glazing with skylight contractor. See Section 08 950.

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 just before each glazing unit is installed.
- F. 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.

3.5 GASKET GLAZING (DRY)

- A. Fabricate compression gaskets in 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. 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. Install gaskets so they protrude past face of glazing stops.

3.6 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.
- C. 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; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 08800

SECTION 09 2216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes non-load-bearing steel framing members for the following applications:
 - 1. Interior framing systems (e.g., supports for partition walls, framed soffits, furring, etc.).
 - 2. Interior suspension systems (e.g., supports for ceilings, suspended soffits, etc.).

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Provide information sufficient to show compliance for the suspended ceiling:
- C.
 - 1. Comply with requirements of seismic design category 'D'.
- D.
 - 2. Provide submittal showing compliance with ASTM C636, CISA guidelines and ASCE7 section 13.5.6

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. Sound Transmission Characteristics: For STC-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- C. Coordination of Trades: It is the responsibility of both the General Contractor and/or the Finish-Subcontractor to verify that the framing is straight, plumb, and square, if that is the intent of the design of the surface of each space, prior to the installation of the wall and ceiling materials.

PART 2 - PRODUCTS

2.1 NON-LOAD-BEARING STEEL FRAMING, GENERAL

- A. Recycled Content of Steel Products: Provide products with average recycled content of steel products such that postconsumer recycled content plus one-half of pre-consumer recycled content is not less than 25 percent.
- B. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
 - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
 - 2. Protective Coating: manufacturer's standard corrosion-resistant zinc coating, unless otherwise indicated.

2.2 SUSPENSION SYSTEM COMPONENTS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch-diameter wire, or double strand of 0.0475-inch-diameter wire.
- B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch diameter.
- C. Flat Hangers: Steel sheet.
- D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch-wide flanges.
 - 1. Depth: 2-1/2 inches or as per manufacturers recommendation for this layout.
- E. Furring Channels (Furring Members):
 - 1. Cold-Rolled Channels: 0.0538-inch bare-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
 - 2. Steel Studs: ASTM C 645.
 - a. Minimum Base-Metal Thickness: 0.0179 inch
 - b. Depth: As indicated on Drawings
 - 3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
 - a. Minimum Base Metal Thickness: 0.0179 inch
- F. Grid Suspension System for Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Armstrong World Industries, Inc.; Drywall Grid Systems.

- b. Chicago Metallic Corporation; 640-C Drywall Furring System.
 - c. USG Corporation; Drywall Suspension System.
 - d. Or equal
- G. Firestop Track: Metal continuous track at top of wall with expansion / contraction capabilities.
 - 1. FIRETRAK Deflection Track: Standard deep leg ceiling runner of depth necessary with Fire Trak
 - a. Product: Subject to compliance with the requirements, provide "Posi Klips" manufactured by Fire Trak Corp., Watkins, MN, 800-394-9875.
 - 2. Deflection and Firestop Track: Top of wall runner designed to allow head-of-walls to compress or extend with movement of structure above while maintaining the fire-rating of the wall assembly. Comply with requirements of ASTM C 645, of thickness indicated for studs and of width to accommodate depth of studs indicated with flanges offset to accommodate gypsum board thickness. The fire-rated assembly shall be capable of 1 inches of movement as required and indicated on the drawings. The assemblies shall have been tested and listed by a code approved laboratory to accommodate the required movement.
 - a. Product: Subject to compliance with the requirements, provide "Fire Trak" manufactured by Fire Trak Corp., Watkins, MN, 800-394-9875
- H. Flat Stap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 - 1. Minimum Base-Metal Thickness: 0.0179 inch Retain first paragraph and subparagraphs below for channel bridging for fixture attachment or lateral bracing. Indicate locations and details of installation on Drawings.
- I. Cold-Rolled Channel Bridging: 0.0538-inch bare-steel thickness, with minimum 1/2-inch-wide flanges.
 - 1. Depth: As indicated on Drawings.
 - 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.
- J. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 - 1. Minimum Base Metal Thickness: 0.0179 inch
 - 2. Depth: 7/8 inch
- K. Sound Clips: isoTRAX Soundproofing System as basis of design designed to reduce sound transmission of wall systems indicated on the Drawings.
 - 1. Isolation Rails with pre-applied sound deadening continuous strip applied directly to isolation rail.
 - 2. Isolation screws.
 - 3. Isolation pads.
 - 4. Sound Rating STC no less than 52

5. Install as per manufacturers installation guidelines and recommendations.
- L. Cold-Rolled Furring Channels: 0.0538-inch bare-steel thickness, with minimum 1/2-inch-wide flanges.
 1. Depth: As indicated on Drawings.
 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare-steel thickness of 0.0312 inch.
 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch-diameter wire, or double strand of 0.0475-inch-diameter wire.
- M. Z-Shaped Furring: With slotted or non-slotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum bare-metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

2.3 AUXILIARY MATERIALS

- A. Fasteners for Metal 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 one of the following:
 1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), non-perforated.
 2. 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 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

3.2 INSTALLING SUSPENSION SYSTEMS

- A. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- B. 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, counters playing, 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 as defined in the differed submittal requirements.
 3. Do not attach hangers to steel roof deck.
 4. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 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.
- C. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- D. Seismic Bracing: Sway-brace suspension systems with hangers used for support for seismic category 'D'. Grid suspension systems are suitable for use with gypsum board. They might not be acceptable for gypsum veneer plaster; consult gypsum veneer plaster and grid suspension system manufacturers before specifying them.
- E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- F. 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.

3.3 INSTALLING FRAMED ASSEMBLIES

- A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- B. Where studs are installed directly against new or existing walls assuming the design of the exterior masonry walls are not intentionally sloped and corners are not angled, apply studs against the exterior masonry wall, only if, masonry wall will allow studs to be plumb and corners square otherwise shim and/or layout furring as needed to provide plumb and straight walls and square corners.
- C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
 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 runner 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.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
- D. Direct Furring:
1. Screw to wood framing.
 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
- E. 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.

END OF SECTION 09 2216

SECTION 09 2900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Interior gypsum board.
2. Tile backing panels.

B. Related Sections include the following:

1. Section 06 1600 "Sheathing" for gypsum sheathing for exterior walls.
2. Division 09 Section "Gypsum Board Shaft Wall Assemblies" for metal shaft-wall framing, gypsum shaft liners, and other components of shaft-wall assemblies.
3. Division 09 painting Sections for primers applied to gypsum board surfaces.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Data shall include certification that each product complies with ASTM requirement noted below.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and pre-consumer recycled content and cost.
2. Laboratory Test Reports: For ceiling and wall materials, indicating compliance with requirements for low-emitting materials.

C. Samples: None required.

1.3 QUALITY ASSURANCE

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. Ceiling and wall materials shall comply with the requirements of California Department of public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects.

1. Build sample panels for each texture specified for both ceilings and walls in sizes approximately 48 inches long by 48 inches high.
2. Mockup may be built in place and the approved mockup may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 INTERIOR GYPSUM BOARD

- A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Gypsum Co.
 - b. G-P Gypsum.
 - c. National Gypsum Company.
 - d. USG Corporation.
 - e. CGC Inc.
 - f. Certaineed Gypsum Inc.
 - g. United States Gypsum Co.
 2. Reference drawings for UL Design Assemblies required Gypsum Board type(s) and thicknesses.
- B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 percent
- C. Regular Type:
1. Core: 1/2 inch or 5/8 inch.
 2. Long Edges: Tapered
- D. Type X:
1. Core: 1/2 inch or 5/8 inch.
 2. Long Edges: Tapered.
- E. Type C:
1. Core: 1/2 inch or 5/8 inch.
 2. Long Edges: Tapered.
- F. Ceiling Type: Manufactured to have more sag resistance than regular-type gypsum board.
1. Core: 1/2 inch
 2. Long Edges: Tapered.
- G. Abuse-Resistant Type: Manufactured to produce greater resistance to surface indentation and through-penetration (impact resistance) than standard, regular type and type X gypsum board.
1. Basis of Design Product: Provide fiberrock VH1 or a comparable product by another manufacturer.
 2. Core: 1/2 inch or 5/8 inch (15.9 mm), Type X.

3. Long Edges: Tapered.

H. USG Products for UL Design Designations:

1. Use products listed below based on the products listed in the UL Designs- see Drawings for UL Design Numbers.
2. For comparable products by other Manufacturers, allowed in the UL Designs, consult website for comparable listing of products as listed in the UL Assembly.

UL Type Designation	Product Systems	UL Type Designation	Product Systems
Gypsum Board and Related Products		Acoustical Suspension Products	
SCX	SHEETROCK FIRECODE Core gypsum panels	CM	CELEBRATION™ Metal ceiling panels(metallic)
SCX	SHEETROCK MOLD TOUGH FIRECODE Core gypsum panels	CP	CELEBRATION™ Metal ceiling panels(painted)
C	SHEETROCK FIRECODE C Core gypsum panels	DXL	DONN DXL suspension system (15/16" wide)
C	SHEETROCK MOLD TOUGH FIRECODE C Core gypsum panels	DXL (15/16" wide)	DONN DXL concealed suspension system
AR	SHEETROCK abuse-resistant gypsum panels	DXLA	DON DXLA suspension system
AR	SHEETROCK MOLD TOUGH FIRECODE AR	ZXLA	DONN ZXLA suspension system (15/16", environmental)
SLX	SHEETROCK gypsum liner panels	DXLT	CENTRICITEE suspension system (9/16" wide)
SLX	SHEETROCK MOLD TOUGH gypsum liner panels	DXLTA DXLF	USG Fire-Resistant Assemblies CENTRICITEE® suspension system (9/16" wide aluminum cap) FINELINE® suspension system (9/16")
SLX	SHEETROCK glass-mat gypsum liner panels		
ULTRACODE	SHEETROCK ULTRACODE Core gypsum panels		
SHX	SHEETROCK FIRECODE Core gypsum sheathing	SDXL	SIMPLICITEE suspension system (15/16" wide, retail)
USGX	SECUREROCK™ glass-mat sheathing FIRECODE Core	SDXL	SIMPLICITEE suspension system (15/16" wide, retail)
SGMRX	SECUREROCK glass mat roof board	SDXLA	SIMPLICITEE suspension system (15/16" wide, retail, aluminum cap)
GMIP	5/8" SHEETROCK Glass-Mat panels Mold Tough FIRECODE X	DGL	USG Drywall Suspension System (15/16" wide)
FC30	SHEETROCK UltraLight Panels FIRECODE 30	DGLW	USG Drywall Suspension System (1-1/2" wide)
ULX	SHEETROCK UltraLight Panels FIRECODE X	DXLP	PARALINE® linear metal ceiling system
FRX-G	FIREROCK Panels	PAR, PARP	PARALINE linear metal ceiling system (linear metal panels)
IP-X1	IMPERIAL FIRECODE Core plaster base	PAS, PASP	PARALINE linear metal ceiling system (linear metal panels)

IP-X2	IMPERIAL FIRECODE C Core plaster base	PSR, PSRP	PARALINE linear metal ceiling system (linear metal panels)
DCB	DUROCK cement board Next Gen	PSS, PSSP	PARALINE linear metal ceiling system (linear metal panels)
UC	ULTRAWALL gypsum panel		
RLX	ROCKLATH FIRECODE gypsum Lath		
LEVELROCK	LEVELROCK floor underlayment mixtures		
AS	SHEETROCK acoustical sealant		
FC	FIRECODE compound		
RFC	FIRECODE ready mixed compound		
A	FIRECODE acrylic firestop spray		
IA	FIRECODE intumescent acrylic firestop sealant		
SA	FIRECODE acrylic firestop sealant		
SA	FIRECODE smoke-sound sealant		
Acoustical Tile and Panel Products			
AP	SANDRIFT™, FROST™, GLACIER™ ceiling panels		
AP-1	SANDRIFT, FROST, GLACIER ceiling panels		
AP-2	FROST, GLACIER, SANDRIFT ceiling panels		
AP-3	FROST, GLACIER, SANDRIFT		
FC-CB	SHEETROCK lay-in ceiling panels CLIMAPLUS™		

FR-83 AND FR-2	Fissured, RADAR™, RADAR Illusion, RADAR CLIMAPLUS, RADAR CLIMA PLUS Illusion, RADAR CLIMAPLUS HIGH NRC, RADAR CLIMAPLUS HIGH CAC, RADAR CLIMAPLUS HIGH NRC/High CAC, Touchstone CLIMAPLUS, ROCK FACE® CLIMAPLUS ceiling panels
FR-4	RADAR Ceramic CLIMAPLUS ceiling panels
FR-X1	ECLIPSETM CLIMA PLUS, MELLENIA® CLIMA PLUS ceiling panels
M	CLEAN ROOM™ Class 10M-100M, Class 100 CLIMAPLUS ceiling panels
ASTRO-FR	ASTRO™ CLIMAPLUS ceiling panels

2.2 GYPSUM TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Board with Water-Resistant Coating: ASTM C1178/C 1178M.
 - 1. Basis of Design Product: Subject to compliance with requirements, provide G-P Gypsum Corporation "DensShield Tile Backer" or a comparable product by another manufacturer.
 - 2. Core: 5/8 inch (15.9 mm), Type X.
 - 3. Long Edges: Square

2.3 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
 - 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
 - 2. Shapes:
 - a. Cornerbead.
 - b. Bullnose bead.

2.4 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 - 1. Interior Gypsum Wallboard: Paper.
 - 2. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints 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 setting-type taping compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 3. Fill Coat: For second coat, use setting-type, sandable topping.
 - 4. Finish Coat: For third coats (and as many as needed), to achieve finish levels indicated, use setting-type, sandable topping.

2.5 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
 - 1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inchthick.

2.6 TEXTURE FINISHES

- A. Primer: As recommended by textured finish manufacturer.
- B. Aggregate Finish: Water-based, job-mixed, aggregated, drying-type texture finish for spray application.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. G-P Gypsum; Georgia-Pacific Ceiling Textures/Vermiculite.
 - b. USG Corporation; SHEETROCK Wall and Ceiling Spray Texture (Aggregated).
 - 3. Texture:
 - a. All Rooms All Walls, excludes walls receiving tile finish:
 - 1) Ceiling- "Smooth" over Level 4.
 - 2) Walls- "Imperfect Smooth" texture over level 4.

PART 3 - EXECUTION

3.1 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Examine framing before installation and correct framing which will not allow gypsum board to have 90 degree corners and straight faces which will allow for the level of finish specified. This requirement governs unless the design of the wall surfaces and corners are noted otherwise in the Construction Documents.
 - 1. Walls: Correct wall framing or shim as needed so that prior to applying the gypsum board panels the wall framing will allow the gypsum board face to be plumb vertically. Variation from top to bottom of wall should not vary more than 1/8 inch.

- a. If wall is not plumb, but angled from plumb, as noted in the drawings. The plane of the wall from top to bottom will not vary more than 1/8 inch.
- D. 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.
- E. 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.
- F. 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.
- G. Form control and expansion joints with space between edges of adjoining gypsum panels.
- H. 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.
- I. 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.
- J. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. 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.
- K. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- L. 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.
- M. 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 C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

3.2 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Regular Type: Only as indicated on Drawings.
 - 2. Type X: Vertical surfaces, use this product everywhere, unless otherwise indicated on Drawings.
 - 3. Ceiling Type: Ceiling surfaces.
 - 4. Abuse-Resistant Type: As indicated on Drawings.
 - 5. Gypsum Tile Backing Panels: At restrooms and/or shower areas and kitchens (on all walls and ceilings whether it's a backer for tile or not, Janitors closets, behind drinking fountains, behind any ceiling and wall tile where tile is indicated on the Drawings.)

3.3 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. Interior Trim: Install in the following locations:
 - 1. Corner bead: Use at outside corners.

3.4 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 paint. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
 - 1. If the gypsum board is existing and is required to be painted as per the Finish Schedule prefill damaged surface areas to allow for a finish level as noted in 3.4.D.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 3: Walls and Ceiling of all surfaces receiving a texture as noted above.
 - 3. Level 4: All non-tiled wall and ceiling surfaces to which a texture, as noted in section 2, will be applied.
 - a. Primer and its application to surfaces are specified in other Division 09 Sections.

- E. Glass-Mat, Water-Resistant Backing Panels: When behind tile and stone tile finish according to manufacturer's written instruction. If surface is to be exposed to view finish as per gypsum board finish levels in 3.4.D
- F. Abuse-Resistant Type: Finish according to manufacturer's written instructions and as per levels noted in gypsum board finish levels in 3.4.D.

3.5 APPLYING TEXTURE FINISHES

- A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.
- B. Texture Finish Application: Mix and apply finish using powered spray equipment, to produce a uniform texture matching approved mockup and free of starved spots or other evidence of thin application or of application patterns.
- C. Prevent texture finishes from coming into contact with surfaces not indicated to receive texture finish by covering them with masking agents, polyethylene film, or other means. If, despite these precautions, texture finishes contact these surfaces, immediately remove droppings and overspray to prevent damage according to texture-finish manufacturer's written recommendations.

3.6 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 2900

SECTION 09 3000 - TILING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Porcelain floor tile.
2. Porcelain wall tile.
3. Glazed ceramic wall tile.
4. Stone thresholds installed as part of tile installations.
5. Waterproof membrane for thin-set tile installations.
6. Crack-suppression membrane for thin-set tile installations.
7. Sealants as part of tile/membrane assembly.
8. Metal edge strips installed as part of tile installations.
9. Floor prep, wall prep and mortar beds.

B. Related Sections include the following:

1. Division 03 Section "Cast-in-Place Concrete" for monolithic slab finishes specified for tile substrates.
2. Division 07 Section "Joint Sealants" for expanded list of sealants other than those listed in this section for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
3. Division 09 Section "Gypsum Board" for gypsum tile backing panels.

1.2 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in its "Specifications for Installation of Ceramic Tile."
- C. Module Size: Actual tile size plus joint width indicated.
- D. Face Size: Actual tile size, excluding spacer lugs.

1.3 PERFORMANCE REQUIREMENTS

- A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:
 1. Level Surfaces: Minimum 0.6.

2. Step Treads: Minimum 0.6.
3. Ramp Surfaces: Minimum 0.8.

1.4 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Sustainable Design Submittals:
 1. Product Data: For adhesives, indicating VOC content.
 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
 3. Laboratory Test Reports: For sealers, indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints.
- D. Provide latest TCNA installation to be used for each tile installation - coordinate with the Interior Tile Installation Schedule at the end of this Section.
- E. Samples:
 1. Each type, composition, color, and finish of tile.
 2. Thresholds in 6-inch lengths.

1.5 EXTRA MATERIALS

- A. Furnish extra materials described below 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 3 percent of full-size units for each type, composition, color, pattern, and size indicated.
 2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.6 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 Foreman Certification.
 3. Installer employs Ceramic Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of each type of floor tile installation.
2. Build mockup of each type of wall tile installation.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- 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.

1.8 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.

PART 2 - PRODUCTS

2.1 GENERAL

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
 1. Basis-of-Design Product: The design of each tile type is based on the product named in the legend(s) found at the end of this section and within the Construction Drawings. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified and based on substitution request approval.
 2. See Div 01 Section 01 2500 for "Substitution Procedures".

2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.
 1. Provide tile complying with Standard grade requirements, unless otherwise indicated.
 2. For facial dimensions of tile, comply with requirements relating to tile sizes specified in Part 1 "Definitions" Article.

- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI standards referenced in "Setting and Grouting Materials" Article.
- C. Colors, Textures, and Patterns: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:
 - 1. As selected by Architect from manufacturer's full range.
- D. Factory Blending: For tile exhibiting color variations within ranges selected during Sample submittals, 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.
- E. 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.
- F. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.3 TILE PRODUCTS

- A. Available Manufacturers: Basis-Of-Design: Daltile Floor HAUT MONDE Stone Attache Collection – Colorbody Porcelain. The following are approved manufacturers that may be considered for a comparable product as part of the request for a substitution:
 - 1. Arizona Tile; www.arizonatile.com.
 - 2. Floridatile; (800) 352 8453
 - 3. Bedrosians Tile; Stone; www.bedrosians.com
- B. Wall Tiles (WF - "x"):
 - 1. Basis-of-Design Product: See 'FINISH LEGEND-WALL' Schedule located in the Architectural drawings.
 - 2. Grout:
 - a. Grout width: 1/8" typical.
 - b. Grout sealer: All Joints.
 - 3. Tile size: Indicated on drawings 'FINISH LEGEND'.
- C. Floor Tiles (FF - "x"):
 - 1. Basis-of-Design Product: See 'FINISH LEGEND-FLOOR' Schedule located in the Architectural drawings.

2. Grout:
 - a. Grout width: 1/8", typical.
 - b. Grout sealer: All joints.
3. Tile size: indicated on drawings 'FINISH LEGEND'.

D. Floor Base (BF – "x")

1. Basis-of-Design Product: See 'FINISH LEGEND-BASE' Schedule located in the Architectural drawings.
2. Grout:
 - a. Grout width: 1/8", typical.
 - b. Grout sealer: All joints.
3. Tile size: Indicated on drawing 'FINISH LEGEND'.

2.4 THRESHOLDS

- A. Thresholds: Fabricate to provide transition between adjacent floor finishes. Bevel edges at 1:2 slope, limit height of bevel to 1/2 inch or less, and finish bevel to match face of threshold.
1. Granite Thresholds: ASTM C 615, with honed finish, unless noted otherwise by Interior Designer.

2.5 WATERPROOF MEMBRANE

- A. General: Manufacturer's standard product that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Chlorinated-Polyethylene-Sheet Product: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric, 0.030-inch nominal thickness.
1. Basis-of-Design Manufacture/Product:
 - a. Noble Company (The); Nobleseal TS.
 - 1) NobleSeal TS bond coat: Noble Bond 21.
 - 2) NobleSeal TS weld: NobleWeld 100.
- C. Polyethylene Sheet: Polyethylene faced on both sides with fleece webbing; 0.008-inch nominal thickness.
1. Basis-of-Design Manufacture/Product:
 - a. Schluter Systems L.P.; KERDI.
 - 1) Schluter Systems L.P.; KERDI-BAND.
 - 2) Schluter Systems L.P.; KERDI-KERECK-F, SEALS.

- D. Waterproofing and Tile-Setting Adhesive:
 - 1. Adhesives shall have a VOC content of 65 g/L or less.
 - 2. Adhesive shall 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."

2.6 CRACK ISOLATION MEMBRANE

- A. General: Manufacturer's standard product that complies with ANSI A118.12 for standard performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; 0.30-inch nominal thickness.
 - 1. Basis-of-Design Manufacture/Product:
 - a. Noble Company (The); Nobleseal CIS.
 - 1) NobleSeal TS bond coat: NobleBond 21.
- C. Corrugated Polyethylene: Corrugated with dovetail-shaped corrugations and with anchoring webbing on the underside; 3/16-inch nominal thickness.
 - 1. Basis-of-Design Manufacture/Product:
 - a. Schluter Systems L.P.; DITRA.
 - 1) Schluter Systems L.P.; KERDI-BAND and KERDI-FLEX.
 - 2) Schluter Systems L.P.; KERDI-KERECK-F, SEALS.
- D. Crack Isolation Membrane and Tile-Setting Adhesive:
 - 1. Adhesives shall have a VOC content of 65 g/L or less.
 - 2. Adhesive shall 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."

2.7 SETTING AND GROUTING MATERIALS

- A. Available Manufacturers:
 - 1. Atlas Minerals & Chemicals, Inc.
 - 2. Boiardi Products Corporation.
 - 3. Bonsal, W. R., Company.
 - 4. Bostik.
 - 5. C-Cure.
 - 6. Custom Building Products.
 - 7. DAP, Inc.

8. Jamo Inc.
 9. LATICRETE International Inc.
 10. MAPEI Corporation.
 11. Southern Grouts & Mortars, Inc.
 12. Summitville Tiles, Inc.
 13. TEC Specialty Products Inc.
- B. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.1A.
- C. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.
1. Basis-of-Design Manufacture/Product:
 - a. Mapei Corporation; Ultraflex 1.
- D. Polymer-modified full contact mortar (Thin Set) for a sloped "medium bed": ANSI A118.4.
1. Basis-of-Design Manufacture/Product:
 - a. Mapei Corporation; Ultracontact or Ultracontact RS or equal.
- E. Polymer-Modified Tile Grout: ANSI A118.7.
1. Basis-of-Design Manufacture/Product:
 - a. Mapei Corporation; Keracolor S, Keracolor U.
 - b. Color: As selected by Interior Designer from manufacturers color palette.
- F. Premium Epoxy Mortar and Grout: ISO 13007 - Classification R2/RG, ANSI - Meets A118.3 requirements. Water cleanable, 100%-solids, high strength epoxy mortar and chemical-resistant nonsagging grout.
1. Basis-of-Design Manufacture/Product:
 - a. Mapei Corporation; Kerapoxy.
 - b. Color: As selected by Interior Designer from manufacturers color palette.
- G. Water-Cleanable, Tile-Setting Epoxy
1. Adhesives shall have a VOC content of 65 g/L or less.
 2. Adhesive shall 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."
- H. Organic Adhesive
1. Adhesives shall have a VOC content of 65 g/L or less.
 2. Adhesive shall 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."
- I.

2.8 ELASTOMERIC SEALANTS

- A. General: Provide sealants, primers, back rods, and other sealant accessories that comply with and are recommended by the tile and membrane manufacturer and with the applicable requirements in Section 07 9200 "Joint Sealants".
- B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.
- C. One-Part, Mildew-Resistant Silicone: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for in-service exposures of high humidity and extreme temperatures.
 - 1. Basis-of-Design Manufacture/Products:
 - a. Noble Company (The); NobleSealant 150.
 - b. Mapei; Keracaulk S (sanded), Keracaulk U (unsanded).
 - c. Schluter Systems L.P.; KERDI-FIX.
 - d. Dow Corning Corporation; Dow Corning 786.
 - e. GE Silicones; Sanitary 1700.
- D. One-Component, self-leveling elastomeric polyurethane sealant, Type S: ASTM C 920; Grade P; Class 25; Uses T, M, A, G and O.
 - 1. Basis-of-Design Manufacture/Products:
 - a. Mapei; Mapeflex P1 SL.

2.9 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials.
- B. Metal Edge Strips: Satin anodized aluminum or nickel silver exposed-edge material.
 - 1. Basis-of-Design Manufacture/Products:
 - a. Schluter Systems; Schiene AE (H=thickness of tile).
 - b. Schluter Systems; Reno-TK H=thickness of tile); use only to provide for smooth floor transitions when flooring thicknesses differ.
- C. Grout Sealer: Manufacturer's standard silicone product for sealing grout joints that does not change color or appearance of grout.
 - 1. Basis-of-Design Manufacture/Product:
 - a. Miracle Sealants Company; 511 Porous Plus grout sealer.

- D. Products shall comply 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."

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 installed tile.
 - 1. Verify that substrates for setting tile are firm; dry; clean; free of oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 Series of tile installation standards for installations indicated.
 - 2. Verify that substrates allow for the tile installation of inside and outside corners will be 90 degrees, unless noted otherwise.
 - 3. 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 before installing tile.
 - 4. 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 and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials.
- B. Provide concrete substrates for tile floors installed with thin-set mortar that comply with flatness tolerances specified in referenced ANSI A108 Series of tile installation standards.
 - 1. Fill cracks, holes, and depressions with trowelable leveling and patching compound according to tile-setting material manufacturer's written instructions. Use product specifically recommended by tile-setting material manufacturer.
 - 2. Remove protrusions, bumps, and ridges by sanding or grinding.
- C. Floor Slope: At "wet" locations i.e. restrooms, showers and others, if a floor drain is indicated the floor should be prepped so that it slopes to the drains.
 - 1. Thick-set mortar bed: If conditions allow for a thick-set cement mortar bed provide a slope as indicated on the plans, if not, provide a default slope to the drain of 1/8" per foot or slope to the maximum extent possible and in the best direction as related to room layout. Reference slab plan for location of Thick-Set mortar bed. Verify recesses slab depth with installation system used per TCNA applicable application.
- D. Blending: For tile exhibiting color variations within ranges selected during Sample submittals, 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. Field-Applied Temporary Protective Coating: Where 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, GENERAL

- A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.
- B. TCNA Installation Guidelines: TCNA's "Handbook for Ceramic Tile Installation." Comply with TCNA installation methods indicated in ceramic tile installation schedules.
- C. 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.
- D. 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.
- E. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.
 - 1. 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.
 - 2. Tile floor joints are parallel to the walls, unless noted otherwise.
- F. Lay out tile wainscots to next full tile beyond dimensions indicated.
 - 1. The top/sides of wainscots must end in a return to the wall to provide the typical grout joint width. Provide a bull-nosed tile plus, tile strip if needed, to cover substrate or brown-coat thickness to allow for the last joint to be a typical grout joint width. If the tile backing substrate is flush the full height of the wall surface i.e. the condition referenced above doesn't exist, the last tile should have a surface bull-nose, unless noted otherwise.
- G. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
 - 1. Locate joints in tile surfaces directly above joints in concrete substrates.
 - 2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

- H. Grout tile to comply with requirements of the following tile installation standards:
 - 1. For ceramic tile grouts, latex-portland cement grouts, comply with ANSI A108.10.
 - 2. Use cement based grouts typically with the following exceptions:
 - a. Epoxy grout is to be used at the Kitchen, Bath and Locker Room Areas (including showers and change areas, sauna, soak tub).
- I. At showers, tubs, and where indicated, install gypsum tile backing panels, ASTM C1178/C/1178M and treat joints with 2" glass fiber mesh tape or per panel manufacturer's written instructions for type of application indicated.

3.4 WATERPROOFING INSTALLATION

- A. Install waterproofing to comply with ANSI A108.17, A108.13, TCNA Handbook, and waterproofing manufacturer's written instructions to produce waterproof membrane of uniform thickness bonded securely to substrate.
- B. Do not install tile over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

3.5 CRACK ISOLATION MEMBRANE INSTALLATION FOR FULL COVERAGE

- A. Install crack isolation membrane to comply with ANSI A108.17, TCNA Handbook Method F-125-Full, and manufacturer's written to produce membrane of uniform thickness bonded securely to substrate.
- B. Do not install tile or setting materials over crack isolation membrane until membrane has cured.

3.6 FLOOR TILE INSTALLATION

- A. General: Install tile to comply with requirements in the Floor Tile Installation Schedule, including those referencing TCA installation methods and ANSI A108 Series of tile installation standards.
 - 1. For installations indicated below, follow procedures in ANSI A108 Series tile installation standards for providing 95 percent mortar coverage.
 - a. Tile floors in wet areas.
 - b. Tile floors composed of tiles 8 by 8 inches or larger.
- B. Stone Thresholds: Install stone thresholds at locations indicated; set in same type of setting bed as abutting field tile, unless otherwise indicated.
 - 1. Set thresholds in latex-portland cement mortar for locations where mortar bed would otherwise be exposed above adjacent non-tile floor finish.
 - 2. Adapt install to manufacturer's recommendations based on threshold type as specified by Interior Designer.

- C. Metal Edge Strips: Install at locations indicated or where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.
- D. Grout Sealer: Apply grout sealer to cementitious grout joints according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer that has gotten on tile faces by wiping with soft cloth.

3.7 WALL TILE INSTALLATION

- A. Install types of tile designated for wall installations to comply with requirements in the Wall Tile Installation Schedule, including those referencing TCA installation methods and ANSI setting-bed standards.

3.8 CLEANING AND PROTECTING

- A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Remove latex-portland cement grout residue from tile as soon as possible.
 - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. 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. Remove temporary protective coating by method recommended by coating manufacturer that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent it from clogging drains.
- B. When recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.
- C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

3.9 FLOOR TILE INSTALLATION SCHEDULE

- A. Interior floor installation On-Ground or Above-Ground Concrete Unbonded Mortar Bed; TCNA F111-13.
 - 1. Thin-Set Mortar: Latex portland cement mortar.
 - 2. Grout: Polymer-modified sanded grout or epoxy grout.
 - 3. Joints: Use appropriate TCNA joint detail.
- B. Interior floor installation on On-Ground concrete; thin-set mortar; TCA F113-13.

1. Thin-Set Mortar: Latex portland cement mortar.
2. Grout: Polymer-modified sanded grout.
3. Joints: Use appropriate TCNA joint detail.

C. Interior floor installation on Above-Ground concrete; thin-set mortar; F113A-13.

1. Thin-Set Mortar: Latex portland cement mortar.
2. Grout: Polymer-modified sanded grout.
3. Joints: Use appropriate TCNA joint detail.

D. Joints per TCNA:

1. Expansion Joint: Use EJ171C-13.
2. Isolation/Expansion Joint: Use EJ171D-13.

3.10 WALL TILE INSTALLATION SCHEDULE

A. Interior wall installation over glass-mat, water-resistant backer board; thin-set mortar; TCA W245-13.

1. Thin-Set Mortar: Latex portland cement mortar.
2. Grout: Polymer-modified sanded and polymer-modified un-sanded grout.
3. Perimeter Movement Joint: EJ171J-13.

3.11 SHOWER RECEPTOR INSTALLATION SCHEDULE

A. Shower Receptors: Wood or metal studs over coated glass mat water-resistant gypsum backer board walls; cement mortar bed (thickset), ceramic tile; TCNA B420-13

1. Bond Coat/Thin-Set Mortar: Latex-portland cement mortar.
2. Grout: Epoxy grout.
3. Joints: Use appropriate TCNA joint detail.

3.12 STEAMSHOWER/ROOM INSTALLATION SCHEDULE

A. Wood or metal studs over coated glass mat water-resistant gypsum backer board walls; cement mortar bed (thickset), ceramic tile; TCNA SR614-13

1. Bond Coat/Thin-Set Mortar: Latex-portland cement mortar.
2. Grout: Epoxy grout.
3. Joints: Use appropriate TCNA joint detail.

3.13 JOINTS

A. Floor joints per TCNA:

1. Expansion Joint: Use EJ171C-13.
2. Isolation/Expansion Joint: Use EJ171D-13.

- B. Wall/Perimeter joints per TCNA:
1. Construction Joints: EJ171A-13.
 2. Perimeter Joints: EJ171I-13.
 3. Contraction Joints: EJ171B-13.
 4. Generic Movement Joint: EJ171F-13.
 5. Perimeter Joint: EJ171G-13
 6. Perimeter Movement Joint: EJ171J-13.

END OF SECTION 09 3000

SECTION 09 51 13 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes acoustical panels and exposed suspension systems for ceilings.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Coordination Drawings: Drawn to scale and coordinating acoustical panel ceiling installation with hanger attachment to building structure and ceiling mounted items:
- C. Samples: For each exposed finish.
- D. Product test reports.
- E. Research/evaluation reports.
- F. Maintenance data.
- G. Sustainable Design Submittals:
 - 1. Product Data: For recycled content, indicating postconsumer and pre-consumer recycled content and cost.
 - 2. Laboratory Test Reports: For ceiling products, indicating compliance with requirements for low-emitting materials.

1.3 QUALITY ASSURANCE

- A. Ceiling products shall comply 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. Acoustical Testing Agency Qualifications: An independent testing laboratory or an NVLAP-accredited laboratory.
- C. Fire-Test-Response Characteristics:
 - 1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - a. Identify materials with appropriate markings of applicable testing and inspecting agency.

2. Surface-Burning Characteristics: Acoustical panels complying with ASTM E 1264 for Class A materials, when tested per ASTM E 84.
 - a. Smoke-Developed Index: 50 or less.
 - b. Flame Spread: 25 or less.
- D. Seismic Standard: Comply with the following:
 1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.
 2. UBC Standard 25-2, "Metal Suspension Systems for Acoustical Tile and for Lay-in Panel Ceilings."
- E. Preinstallation Conference: Conduct conference at Project site.

1.4 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.
 2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANEL CEILINGS, GENERAL

- A. Acoustical Panel Standard: Comply with ASTM E 1264.
- B. Recycled Content: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.
- C. Metal Suspension System Standard: Comply with ASTM C 635.
- D. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated.
- E. Wire Hangers, Braces, and Ties: Zinc-coated carbon-steel wire; ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 1. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire but, provide not less than 0.106-inch-diameter wire.
- F. Seismic perimeter stabilizer bars, seismic struts, and seismic clips.

- G. Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

2.2 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING (for CT-1B, CT-2B, CT-4)

A. Basis-of-Design Product:

1. Rockfon Tropic #SLN1020, NRC: 0.85, CAC 22, 24 x 24 x 5/8 inches
 - a. 5/8" Square Tegular Narrow

Or a comparable product by one of the following:

2. Chicago Metallic Corporation.
3. Ecophon CertainTeed, Inc.
4. Tectum Inc.
5. USG Interiors, Inc.

2.3 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING (for CT-1B, CT-2B, CT-4):

A. Basis-of-Design Product: Subject to compliance with requirements, provide or equal:

1. 4500 – Ultraline 9/16inch with 1/4inch reveal"

B. Components: All main beams and cross tees shall be commercial quality hot-dipped galvanized (galvanized steel, aluminum, or stainless steel) as per ASTM A 653. Main beams and cross tees are double-web steel construction with type exposed flange design. Exposed surfaces chemically cleansed, capping pre-finished galvanized steel (aluminum or stainless steel) in baked polyester paint. Main beams and cross tees shall have rotary stitching (exception: extruded aluminum or stainless steel).

1. Structural Classification: ASTM C 635 Heavy Duty
2. Attachment Devices: In accordance with the IBC, Section for Category D.
3. End Condition of Cross Runners: Override (stepped) or butt-edge type.
4. Cap Material: Steel or aluminum cold-rolled sheet.
5. Cap Finish: (WH) White.

C. Recycled Content: Postconsumer recycled content plus one-half of pre-consumer recycled content no less than 25 percent.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

- B. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders.
- C. Suspend ceiling hangers from building's structural members, plumb and free from contact with insulation or other objects within ceiling plenum. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers, use trapezes or equivalent devices. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 - 1. Do not support ceilings directly from permanent metal forms or floor deck; anchor into concrete slabs.
 - 2. Do not attach hangers to steel deck tabs or to steel roof deck.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
- E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

END OF SECTION 09 5113

SECTION 09 6519 – RUBBER FLOORING

PART 1 – GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
 - 1. Rubber Tile Flooring
 - 2. Substrate Preparation
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
 - 1. Section 03 30 00 CAST-IN-PLACE CONCRETE for concrete substrate; slab surface tolerances
 - 2. Section 06 10 00 ROUGH CARPENTRY for plywood substrate and surface tolerances
- C. References (Industry Standards):
 - 1. ASTM International (ASTM):
 - a. ASTM D2047, Standard Test Method for Static Coefficient of Friction as Measured by the James Machine
 - b. ASTM E648, Standard Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source
 - c. ASTM E662; Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials
 - d. ASTM D2240, Standard Test Method for Rubber Property – Durometer Hardness
 - e. ASTM F970, Standard Test Method for Static Load Limit
 - f. ASTM F970 (Modified), Modified Test Method for Max weight Limit
 - g. ASTM F1515, Standard Test Method for Measuring Light Stability of Resilient Flooring by Color Change
 - h. ASTM F2772, Specification for Athletic Performance Properties of Indoor Sports Floor Systems
 - i. ASTM F2569, Standard Test Method for Evaluating the Force Reduction Properties of Surfaces for Athletic Use.

- j. ASTM F2117, Standard Test Method for Vertical Rebound Characteristics of Sports Surface/Ball Systems; Acoustical Measurement
 - k. ASTM F2157, Standard Specification for Synthetic Surfaced Running Tracks, Vertical Deformation
 - l. ASTM E303, Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester
 - m. ASTM E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
 - n. ASTM E492, Standard Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine
 - o. ASTM E2179, Standard Test Method for Laboratory Measurement of the Effectiveness of Floor Coverings in Reducing Impact Sound Transmission Through Concrete Floors
 - p. ASTM F710, Standard Practice for Preparing Concrete to Receive Resilient Flooring
 - q. ASTM F1482, Standard Guide to Wood Underlayments products Available for Use Under Resilient Flooring
 - r. ASTM F1869, Standard Test Method for Measuring Moisture Vapor Emissions Rate of Concrete Subfloor using Anhydrous Calcium Chloride
 - s. ASTM F2170, Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs using in situ Probes
2. National Fire Protection Association (NFPA):
- a. NFPA 253, Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Energy Source
 - b. NFPA 258, Test Method for Specific Density of Smoke Generated by Solid Materials

1.3 SUBMITTALS

- A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures.
- B. Product Data: Submit manufacturer's technical data sheet, care & maintenance document, submittal and/or warranty for each material and accessory proposed for use.
- C. Samples: Submit representative samples of each product specified for verification, in manufacturer's standard size samples of each resilient product color, texture and pattern required.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Provide resilient flooring materials manufactured in the United States of America by a firm with a minimum of 10 years' experience with resilient flooring materials of type equivalent to those specified.

1. Provide resilient flooring products, including wall base, accessories and subfloor preparation products from one manufacturer to ensure color matching and compatibility.
 2. Manufacturer shall be capable of providing technical training and technical field service representation.
- B. Installer Qualifications: Installer must be professional, licensed, insured and familiar with the resilient flooring material to be installed. Project Managers or Field Supervisors must be INSTALL (International Standards & Training Alliance) certified CFI (Certified Floorcovering Installers) Certified and/or an FCICA (The Flooring Contractors Association) CIM (Certified Installation Manager) for the requirements of the project.
- C. Sustainable Design Requirements:
1. Rubber Tile that has a published EPD.
 2. Rubber Tile that has a published HPD.
 3. Rubber Tile and accessories that are easily cleaned and do not require coatings and stripping, or use chemicals that may be hazardous to human health.
 4. Rubber Tile is SCS FloorScore® Certified and meets California Specifications Section 01350.
 5. Rubber Tile manufactured in a Facility that is ISO 14001 Certified.
 6. Rubber Tile free of materials known to be teratogenic, mutagenic or carcinogenic including halogens, asbestos and chlorines.
 7. Rubber Tile that contributes credits to LEED projects.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in labeled packages. Store and handle in strict compliance with manufacturer's recommendations. Protect from damage due to weather, excessive temperatures, and construction operations.
- B. Deliver materials sufficiently in advance of installation to condition materials to the required temperature for 48-hours prior to installation.

1.6 PROJECT CONDITIONS

- A. Install Rubber Tile after other finishing operations, including painting, have been completed.
- B. Maintain temperature at service levels and/or the ambient temperature must remain steady ($\pm 10^\circ$ F) between 65° F and 85° F for at least 48-hours prior to, during and until substantial completion.
- C. Maintain relative humidity at service levels, or between 40% and 65% RH.
- D. Avoid conditions in which dew point causes condensation on the installation surface.

1.7 WARRANTY

- A. Provide manufacturer's standard limited commercial warranty to cover manufacturing defects

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Basis-of-Design: Roppe Corporation | 1602 N Union St. | Fostoria, OH 44830 | P: (800) 537-9527
- B. Substitutions: substitution permitted
 - 1. Regupol, info@regupol.com – AKCL308, 48inches wide x 5/16inch thick.
 - 2. Mondo, mondo@mondousa.com – Sport Impact, 3'-0" x 3'-0" x 3/8inches thick.

2.2 PRODUCTS

- A. Basis-Of-Design: Roppe TUFLEX RUBBER TILE FLOORING
 - 1. Roppe Tuflex Spartus Rubber Tile Flooring can be used in interior or exterior applications.
 - 2. Manufacturers full range of colors for Architects' selection.
 - 3. Roppe Tuflex Rubber Tile Flooring, Specify Dimensions: Interlocking: 25 3/4" x 25 3/4" x 3/8" (9mm)
 - 4. Thickness: 3/8" (9 mm)
 - 5. Surface Finish: Smooth
 - 6. ASTM D2047, Static Coefficient of Friction; > 0.8
 - 7. ASTM E648/NFPA 253, Critical Radiant Flux; Class 1, > 0.45 W/cm²
 - 8. ASTM E662/NFPA 258, Smoke Density; Passes, < 450
 - 9. ASTM F970, Static Load Limit; Passes 250 PSI
 - 10. ASTM F970, Modified Static Load Limit; Passes 1,000 PSI
 - 11. ASTM F1515, Light Stability; Passes $\Delta E < 8$
 - 12. ASTM F2772, Athletic Performance Properties of Indoor Sports Floor Systems: Passes
 - 13. ASTM F2569, Shock Absorption: Passes Class 1
 - 14. ASTM F2117 – Vertical Ball Rebound: Passes
 - 15. ASTM F2157 – Vertical Deformation: Passes
 - 16. ASTM E303 – Surface Friction, Dry: Passes
 - 17. ASTM E492, Acoustical (Impact Insulation Class) Impact; IIC 52 (6" concrete, no drop ceiling), 67 IIC (6" concrete, with drop ceiling).
 - 18. ASTM E90, Acoustical (Sound Transmission Class) STC 52 (6" concrete, no drop ceiling), STC 63 (6" concrete, with drop ceiling)
 - 19. ASTM E2179, Effectiveness of Floor Covering; $\Delta IIC > 22$
 - 20. Tuflex Spartus Rubber Tile carries a 10 year Limited Warranty when installed following the manufacturer's installation instructions and adhesive recommendations.

2.3 INSTALLATION AND MAINTENANCE MATERIALS

- A. Moisture Mitigation: Moisture testing is required for all Tuflex Rubber Tile installations. Mitigation should be performed if results indicate high levels of moisture. Recommended Moisture Mitigation Product:
1. Excelsior MM-100, Moisture Mitigation provided by Roppe
 - a. Unit Size: 2.5 Gallons
 - b. Coverage: 1000 square feet per unit with one coat
 - c. MM-100 is a water, solvent and VOC free, polyurethane-based moisture mitigation product used to treat concrete slabs with excessive moisture levels beyond what flooring adhesives allow.
 - d. MM-100 can block moisture up to 20 lbs. MVER or 99% RH.
 - e. MM-100 is a single component product, eliminating extensive mix times and concerns regarding pot life.
 - f. MM-100 does not require aggressive concrete preparation, such as shotblasting or diamond grinding.
 - g. MM-100 is not recommended as a moisture mitigation system over a non-porous substrate. The substrate should be porous as per ASTM F3191 with 90% of the original substrate exposed.
 - h. MM-100 is a two coat system that is incredibly easy to apply and does not require any specialized equipment, its excellent coverage rates also make it incredibly cost effective.
 - i. Despite being a two coat system, MM-100 is incredibly fast drying.
 - j. Flooring or subsequent coatings can be installed in less than two hours.
 - k. Backed by a 10 year material and labor warranty, MM-100 is a fast and easy solution for the moisture issues that commonly plague flooring installations.
- B. Substrate Preparation Products: Substrates should be prepared to properly receive the resilient flooring products being specified. Trowelable leveling and patching compounds that are latex-modified, Portland cement based or blended hydraulic cement-based formulation. Select from one of the following recommended substrate preparation products:
1. Excelsior NP-230, Non-Porous Substrate Primer provided by Roppe
 - a. Unit Size: 2.5 Gallons
 - b. Coverage: 1000 Square Feet per unit with one coat
 - c. Used over MM-100 to promote adhesion of cementitious materials
 - d. Single component and fast drying to allow for quick and easy installation
 - e. Contains an aggregate to provide mechanical bond for cementitious materials
 2. Excelsior CP-300, Cementitious Patch provided by Roppe
 - a. Unit Size: 10 lb. Unit
 - b. Coverage: 33 Square Feet per unit @ 1/8"

- c. Doesn't require primer over porous substrates
- d. Install flooring in as little as 30 minutes
- 3. Excelsior SU-310, Self-Leveling Underlayment provided by Roppe
 - a. Unit Size: 50 lb. Bag
 - b. 5500 PSI Compressive Strength after 28 days
 - c. Install flooring within 12 hours
 - d. Pumpable
- C. Adhesives: Adhesives should be selected based on the site conditions and use of the space being installed. Select from one of the following recommended adhesive products:
 - 1. Excelsior MS-700, Modified Silane Wet-Set Adhesive provided by Roppe
 - a. Unit Size: 3 Gallon
 - b. Coverage: 480-705 Square Feet per unit
 - c. Standard installations over porous and non-porous substrates
 - d. Excellent green grab
 - e. Hard set adhesive adding to dimensionally stable materials
 - f. Excellent sheer strength
 - g. Approved for Hill-Rom Beds
 - h. Superior bond strength
 - i. Great for environments with topical moisture
 - j. Great for exterior applications
 - k. Installation Limits, Indoor Installations only
 - (1) 95% RH, ASTM F2170
 - (2) 10 lbs. MVER, ASTM F1869
 - 2. Excelsior U-705, Urethane Wet-Set Adhesive by Roppe
 - a. Unit Size: 3 Gallon
 - b. Coverage: 405-480 Square Feet per unit
 - c. Standard installations over porous and non-porous substrates
 - d. Excellent green grab
 - e. Hard set adhesive adding to dimensionally stable materials
 - f. Excellent sheer strength
 - g. Approved for Hill-Rom Beds
 - h. Superior bond strength
 - i. Great for environments with topical moisture
 - j. Great for exterior applications
 - k. Installation Limits, Indoor Installations only
 - l. No Moisture testing Required
 - 3. Excelsior EW-710, Epoxy Wet-Set Adhesive provided by Roppe

- a. Unit Size: 1 Gallon
- b. Coverage: 120 – 135 Square Feet per unit
- c. Standard installations over porous and non-porous substrates
- d. Excellent green grab
- e. Hard set adhesive adding to dimensionally stable materials
- f. Excellent sheer strength
- g. Approved for Hill-Rom Beds
- h. Superior bond strength
- i. Great for environments with topical moisture
- j. Great for exterior applications
- k. Installation Limits, Indoor Installations only
 - (1) 90% RH, ASTM F2170
 - (2) 6 lbs. MVER, ASTM F1869
 - (3) 7-10 pH

D. Maintenance Materials: Proper maintenance of the installation is critical to the long term performance of the flooring products being specified. Using the appropriate chemicals to maintain the product according to the environment in which it is specified is critical.

Recommend maintenance products:

- 1. Excelsior NC-900, All Purpose Neutral Cleaner
 - a. For initial maintenance
- 2. Excelsior CM-910, Cleaner Maintainer
 - a. For initial and routine maintenance
- 3. Excelsior PF-960, Performance Finish provided by Roppe
 - a. For initial maintenance
- 4. Excelsior PR-930, Performance Remover
 - a. For heavy cleaning and restorative maintenance

PART 3 – EXECUTION

3.1 GENERAL

A. General Contractor Responsibilities:

- 1. Supply a safe, climate-controlled building and subfloor as detailed in Roppe Technical Data Sheets.
- 2. Ensure substrate meets the requirements of ASTM F710, Roppe Technical Data Sheets and Excelsior Technical Data Sheets.
- 3. Provide a secure storage area that is maintained permanently or temporarily at normal operating temperature and humidity conditions between 65° F and 85° F and between 40% and 65% relative humidity, for at least 48-hours prior to and during the application of

the flooring, so the flooring contractor can acclimate the flooring materials per manufacturer's instructions.

4. Provide an installation area that is weather tight and maintained either permanently or temporarily at ambient service temperature and humidity. Normal operating temperature and humidity conditions are between 65° F and 85° F and between 40% and 65% relative humidity, for at least 48-hours prior to and during the application of the flooring per the manufacturer's instructions.
5. Ensure areas with direct prolonged exposure to sunlight are protected with protective UVA/UVB restrictive coatings or films.
6. Areas of the flooring that are subject to direct sunlight through doors or windows should have them covered using blinds, curtains, cardboard or similar for the time of the installation and 72-hours after the installation to allow the adhesive to cure. Note: These areas should be installed using wet adhesives only.
7. Conduct initial maintenance prior to final usage per the Roppe Care & Maintenance Documents. Do not conduct initial maintenance until adhesive has cured per the adhesive technical data.

B. Flooring Contractor Responsibilities:

1. Provide trained installers that are professional, licensed, insured and familiar with the resilient flooring material to be installed.
2. Ensure installers or installation teams meet one of the following requirements:
 - a. Have completed INSTALL (International Standards & Training Alliance) or CFI (Certified Floorcovering Installers) training programs and/or are certified by INSTALL or CFI.
 - b. Are being supervised by Project Managers or Field Supervisors that are INSTALL (International Standards & Training Alliance) certified.
 - c. CFI (Certified Floorcovering Installers) Certified and/or an FCICA (The Flooring Contractors Association) CIM (Certified Installation Manager).
3. Follow all requirements in the appropriate Roppe and/or Excelsior Technical Data Sheets, Care & Maintenance Documents, Warranties and other technical documents or instructions.

3.2 EXAMINATION

- A. General: Follow guidelines laid out in Division 01, Section 01 71 00 – Examination and Preparation, as well as Section 01 43 00 – Quality Assurance.
- B. Verification of Conditions: Inspect all substrates to ensure they are clean, smooth, permanently dry, flat, and structurally sound. Confirm all areas are properly sealed and acclimated per manufacturer's requirements.

- C. Verification of Products: In accordance with manufacturer's installation requirements, visually inspect material for size, color or visual defects prior to installing. Any material that is incorrect or visually defective shall not be installed.

3.3 SUBSTRATE PREPARATION

- A. General: Follow guidelines laid out in Division 01, Section 01 71 00 – Examination and preparation. All work required, ensuring substrate or subfloor meets manufacturers' guidelines are the responsibility of the general contractor.
- B. Preparation: Ensure substrate meets the requirements of ASTM F710 for concrete substrates and ASTM F1482 for wood substrates and/or Roppe Technical Data Sheets and Excelsior Technical Data Sheets.
 - 1. Substrates must be free of visible water or moisture, dust, sealers, paint, sweeping compounds, curing compounds, residual adhesives and adhesive removers, concrete hardeners or densifiers, solvents, wax, oil, grease, asphalt, visible alkaline salts or excessive efflorescence, mold, mildew and any other extraneous coating, film, material or foreign matter.
 - 2. It is recommended that all substrates have a floor flatness of FF32 and/or flatness tolerance of 1/8" in 6' or 3/16" in 10'.
 - 3. Acclimate all products to be used during the installation and the installation environment prior to installation according to the manufacturers written instructions
- C. Concrete Substrates:
 - 1. Moisture Testing: Perform moisture testing per the manufacturer's recommendations to determine conditions, it is recommended to treat new and existing slabs a little bit different to ensure adequate conditions exist for installation.
 - a. New Slabs on all grade levels: it is recommended to perform ASTM F2170 Relative Humidity testing no more than a week prior to installation too determine the levels present and when to proceed with the installation.
 - b. Existing Slabs on all grade levels: in addition to ASTM F2170 testing, existing slabs that have previously had floor covering installed, must be tested to ASTM F1869 Calcium Chloride test kits to determine the MVER of the concrete.
 - 2. Mechanically remove contamination on the substrate that may cause damage to the flooring material, this includes paint, permanent and non-permanent markers, pens, crayons, etc. Leaving these on the substrate or marking with them on the back of the material could cause bleed through and damage the flooring.
 - 3. Fill cracks, holes, depressions and irregularities in the substrate to prevent transferring through to the surface of the resilient flooring. Use a high-quality Portland cement-based product such as Excelsior installation products provided by Roppe.
 - 4. Do not install material over expansion joints.

- D. Wood Substrates: wood substrates must have a minimum 18" (45.7 cm) of cross ventilated space beneath the joist.
1. Wood substrates must be a minimum 1" thick with a double layer construction.
 2. Wood substrates must be rigid and free of movement
 3. Wood substrates must not be OSB (Oriented Strand Board), particle board, chipboard, lauan or composite type underlayments
 4. Wood substrates that are Single Wood or Tongue & Groove subfloors must be covered with the appropriate APA approved underlayment plywood:
 - a. Boards with a face width of 3" (7.62 cm) or less and is tongue-and-groove and with a smooth surface, use minimum 1/4" (6.4 mm) underlayment panels.
 - b. Boards with a face width greater than 3" (7.62 cm) or not tongue-and-groove, or with a rough surface, use minimum 1/2" (12.7 mm) underlayment panels.

3.4 INSTALLATION

- A. General: Follow all relevant guidelines detailed in Division 01, as well as flooring and adhesive manufacturer's technical data sheets.
- B. Rubber Tile: Install material in accordance with manufacturer's recommendations:
1. Select the appropriate adhesive for the application and job site conditions.
 2. Install material according to directional arrows on the back of the material and do not reverse tiles.
 3. Ensure material is rolled appropriately into the adhesive using a 100 lb. three section roller.

3.5 CLEANING & MAINTENANCE

- A. General: Clean up installation area and sweep, dust or wipe material to remove any dirt, dust or debris.
- B. Initial Maintenance: Conduct required initial maintenance per the manufacturer's recommended procedures stated in the Maintenance Documents. All documentation is available upon request or from the Roppe website: www.roppe.com Excelsior Cleaning and Maintenance products are the recommended products for use. All can be found linked to the product on the Roppe website or at www.excelsiorproducts.net.
- C. Regular Maintenance: Conduct maintenance on regular intervals as needed. Insufficient cleaning will reduce the wear life of the flooring. The amount of maintenance depends directly upon the amount of dirt and particulates the floor is subjected to.

3.6 CLOSEOUT ACTIVITIES

- A. General: Follow all federal, state and local requirements and Division 01 Section 01 76 00 – Protecting Installed Construction and Section 01 78 00 – Closeout Submittal requirements for these activities.

- B. Protection: Protect newly installed material with construction grade paper or protective boards, such as Masonite or Ram Board, to protect material from damage by other trades. Be sure all construction debris is swept up and removed prior to the protective material being installed and does not get trapped underneath. Limit usage and foot traffic according to the adhesive's requirements. When moving appliances or heavy furniture, protect wall base from scuffing and tearing using temporary floor protection as well.

END OF SECTION 09 65 19

SECTION 09 6813 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes:
 - 1. Modular carpet tile.
 - 2. Entryway system.

1.2 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Sustainable Design Submittals:
 - 1. Product Data: For adhesives, indicating VOC content.
 - 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
 - 3. Laboratory Test Reports: For flooring products, indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings: Show the following:
 - 1. Carpet tile type, color, and dye lot.
 - 2. Pattern of installation.
 - 3. Edge, transition, and other accessory strips.
 - 4. Transition details to other flooring materials.
- D. Samples: For each color and texture required.
 - 1. Carpet Tile: Full-size Sample.
 - 2. Exposed Edge, Transition, and other Accessory Stripping: 12-inch-long Samples.
- E. Product Schedule: For carpet tile. Use same designations indicated on Drawings.
- F. Maintenance data.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104, Section 5, "Storage and Handling."

1.5 PROJECT CONDITIONS

- A. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."
- B. Environmental Limitations: Do not install carpet tiles until 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.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.6 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, dimensional stability, excess static discharge, and delamination.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Basis-of-Design Product: The design is based on the product named in the basis-of-design and within the Construction Drawings. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other suppliers specified and based on substitution request approval.
- B. See Division 01 Section 01 2500 for "Substitution Procedures".
- C. Provide all products from a single source.

2.2 CARPET TILE

- A. Basis-of-Design Product: Subject to compliance with requirements provide the product supplied from the following manufacturers:

1. Basis-Of-Design shall be Mohawk Group: Modular-Quickship; "Seismic wave", "Step Up 2".
2. Installation: Quarter-Turn.
3. Carpet flammability
 - a. Pill Test (ASTM D2859 or CPSC FF-1-70): Passes
 - b. Radiant Panel Test (ASTM E648): >.45 watts/cm2, Class I
4. Smoke Density (ASTM E662): < 450 Flaming Mode
5. Dimensional Stability (Aachen Method DIN 54318): < 0.1% change
6. Static Generation at 700 F. (AATCC 134 w/neolite): < 2.5 KV at 20% R.H.
7. Lightfastness (AATCC 16E): 4.0 after 60 hours
8. Crocking (AATCC 165): 4.0 wet, dry
9. Cold Water Bleed 4.0
10. Sublimation (AATCC 117): 4.0
11. Gas Fade (AATCC 23): 4.0
12. Ozone Fade (AATCC 109): 4.0
13. Antimicrobial (AATCC 174, part II): > 95.0% reduction
14. Fungicidal (AATCC 174, part III): No growth
15. Soil/Satin Protection (AATCC 175-1991) "Duracolor" > 8.0 on the Red 40 Stain Scale
16. Appearance Retention Rating (ASTM D-5252 or ASTM D-5417): Heavy use classification
17. Yarn Weight 28 oz/yd²
18. Total Thickness 0.271 inches
19. Size 24 in. x 24 in.
20. Base Color Method Solution Dyed

2.3 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, non-staining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.
1. Adhesives shall have a VOC content of 65 g/L or less.
 2. Adhesive shall 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."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.
- C. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- D. Install pattern parallel to walls and borders.

END OF SECTION 09 6813

SECTION 09 91 13 - EXTERIOR 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. This Section includes surface preparation and the application of paint systems on the following exterior substrates:
 - 1. Concrete.
 - 2. Clay masonry.
 - 3. Concrete masonry units (CMU).
 - 4. Steel.
 - 5. Galvanized metal.
 - 6. Aluminum (not anodized or otherwise coated).
 - 7. Exposed dimension lumber (rough carpentry).
 - 8. Plastic trim fabrications.
 - 9. Fiber cement panels and siding.
- B. This Section includes surface preparation and the application of paint systems on typical building exterior substrates- see items listed above and the "Exterior Painting Schedule" at the end of this section, for an indication of items to be painted. Note: This Schedule, while trying to be complete, may not include all surfaces and needs to be augmented with "painting" noted throughout the Construction Drawings, including but not limited to the Room Finish Schedule and the Project Manual.
- C. Related Sections include the following:
 - 1. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.
 - 2. Division 06 Sections for shop priming carpentry with primers specified in this Section.
 - 3. Division 09 Section "Interior Painting" for surface preparation and the application of paint systems on interior substrates.
 - 4. Division 09 Section "High-Performance Coatings" for surface preparation and the application of paint systems for exterior substrates in high traffic areas.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Data: For paints and coatings, indicating VOC content.

- C. Samples for Verification: For each type of paint system and each color and gloss of topcoat indicated.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.

- D. Product List: For each product indicated, include the following:
 - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.4 QUALITY ASSURANCE

- A. MPI Standards:
 - 1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
 - 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

- B. Mockups: Apply benchmark samples 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 specified in Part 3.
 - 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 benchmark samples.
 - a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.6 PROJECT 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 in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
 - 1. Quantity: Furnish 1 gal. of each material and color applied.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Basis-of-Design Product: The design is based on the product named in the basis-of-design and within the Construction Drawings. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified and based on substitution request approval.
- B. See Division 01 Section 012500 for "Substitution Procedures".

2.2 PAINT, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each paint system that are 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, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. VOC Content: For field applications, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
 - 1. Flat Paints and Coatings: 50 g/L.
 - 2. Non-flat Paints and Coatings: 50 g/L.
 - 3. Dry-Fog Coatings: 150 g/L.
 - 4. Primers, Sealers, and Under-coaters: 100 g/L.
 - 5. Rust-Preventative 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.

2.3 PAINT PRODUCTS

- A. See "Exterior Paint Schedule" at the end of this Section.
 1. Basis-of-Design Products: Subject to compliance with requirements provide paint and accessories for a complete painting scope by Sherwin-Williams Co. and product/manufacture listed in Schedule or by one of the following:
 - a. Benjamin Moore & Co.
 - b. Glidden Professional, (Division of PPG)
 - c. Kwal, (Division of Sherwin-Williams)
 - d. PPG Architectural Finishes, Inc.
 - e. Sherwin-Williams Co.

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 work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 1. Masonry (Clay and CMU): 12 percent.
 2. Wood: 15 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 1. Beginning coating application constitutes Contractor's acceptance of substrates 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. Apply wood filler paste to open-grain woods, as defined in "MPI Architectural Painting Specification Manual," to produce smooth, glasslike finish.

- C. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
 - 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- D. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and re-prime substrate with compatible primers as required to produce paint systems indicated.
- E. Concrete Masonry Substrates: Remove 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.
- F. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
- G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- H. Aluminum Substrates: Remove surface oxidation.
- I. Plastic Trim Fabrication Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.
- J. Plaster Substrates: Do not begin paint application until plaster is fully cured and dry.
- K. Exterior Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions.
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
- 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.

3.4 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.

3.5 EXTERIOR PAINTING SCHEDULE (Coordinate these requirements and paint as follows, unless noted otherwise in the Finish Schedule found in the Drawings)

- A. Exterior Floors:
 - 1. Concrete Substrates, Pedestrian Traffic Surfaces:
 - a. First Coat: Floor paint, latex, slip-resistant, matching topcoat.
 - b. Topcoat: Floor paint, latex, slip-resistant, low gloss[, (maximum Gloss Level 3), MPI #60: S-W ArmorSeal Tread-Plex, B90 Series, at 1.5 to 2.0 mils dry per coat.
- B. Exterior Walls:
 - 1. Concrete, Clay Masonry, Portland Cement Plaster (Stucco), Cementitious Siding, Nontraffic Surfaces:
 - a. Latex System:
 - 1) Prime Coat: Primer sealer, latex, exterior, MPI #3: S-W Loxon Concrete & Masonry Primer Sealer, A24W8300, at 8.0 mils wet, 3.2 mils dry.
 - 2) Prime Coat: Latex, exterior, matching topcoat.
 - 3) Intermediate Coat: Latex, exterior, matching topcoat.
 - 4) Topcoat: Latex, exterior, flat, (Gloss Level 1), MPI #10: S-W A-100 Exterior Latex Flat, A6 Series, at 4.0 mils wet, 1.2 mils dry, per coat.
 - 2. CMU Substrates:
 - a. Latex System:

- 1) Block Filler: Block filler, latex, interior/exterior: S-W PrepRite Block Filler, B25W25, at 75 to 125 sq. ft. per gal.
 - 2) Intermediate Coat: Latex, exterior, matching topcoat.
 - 3) Topcoat: Latex, exterior, flat, (Gloss Level 1), MPI #10: S-W A-100 Exterior Latex Flat, A6 Series, at 4.0 mils wet, 1.2 mils dry, per coat.
3. CMU Substrates:
- a. Clear Sealed System:
 - 1) Primer: Sure Klean® Custom Masonry Cleaner by PROSOCO, clear liquied with a slight amber color.
 - 2) Intermediate Coat: Sure Klean® Custom Masonry Sealer by PROSOCO, clear liquid.
 - 3) Topcoat: Sure Klean Siloxane PD by PROSOCO a water-based silane/siloxane water repellent.
- C. Exterior Exposed Rough Carpentry Substrates, Semi-transparent Stain:
1. Basis-of-Design Product: Cabot, Semi-transparent Acrylic Stain- #1300 Series or by substitution:
 - a. Semitransparent Stain System: MPI EXT 6.2L.
 - 1) Two Stain Coats: Exterior semitransparent stain (solvent based).
- D. Exterior Metal Substrates exposed-to-view (Aluminum, Steel, Galvanized Steel):
1. Handrails: Paint as per Section 09 9600 "High-Performance Coatings" for steel substrates, unless noted otherwise.
 2. Guardrails: Paint as per Section 09 9600 "High-Performance Coatings" for steel substrates, unless noted otherwise.
 3. Columns, beams and associated brackets and connections: Paint as per Section 09 9600 "High-Performance Coatings" for steel substrates, unless noted otherwise.
 4. Stair components other than handrails and guards: Paint as per Section 09 9600 "High-Performance Coatings" for steel substrates, unless noted otherwise.
- E. Exterior Metal Substrates exposed-to-view (Aluminum, Steel, Galvanized Steel):
1. Latex System:
 - a. Prime Coat: Primer, rust-inhibitive, water based, MPI #107: S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 5.0 to 10 mils wet, 2.0 to 4.0 mils dry.
 - b. Intermediate Coat: Water-based acrylic, interior, matching topcoat.
 - c. Topcoat: Water-based acrylic, semi-gloss, (Gloss Level 5), MPI #147 X-Green: S-W Pro Industrial Acrylic Semi-Gloss Coating, B66-650 Series, at 2.5 to 4.0 mils dry, per coat.
- F. Exterior Wood Substrates: Including exposed wood items not indicated to receive shop-applied finish:
1. Latex System:

- a. Prime Coat: Primer, latex for exterior wood, MPI #6.
- b. Intermediate Coat: Latex, exterior, matching topcoat.
- c. Topcoat: Latex, exterior, satin, (Gloss Level 3-4), MPI #15: S-W A-100 Exterior Latex Satin, A82 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

G. Exterior Gypsum Board Substrates:

1. Latex System:

- a. Prime Coat: Primer, bonding, water-based, MPI #3: S-W Prep-Rite Pro-Block Latex Primer/Sealer.
- b. Prime Coat: Latex, exterior, matching topcoat.
- c. Intermediate Coat: Latex, exterior, matching topcoat.
- d. Topcoat: Latex, exterior, flat, (Gloss Level 1), MPI #10: S-W A-100 Exterior Latex Flat, A6 Series, at 4.0 mils wet, 1.2 mils dry, per coat.

END OF SECTION 09 9113

SECTION 09 9123 - 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. This Section includes surface preparation and the application of paint systems on typical building interior substrates- see "Interior Painting Schedule" at the end of this section, for an indication of items to be painted. Note: This Schedule, while trying to be complete, may not include all surfaces and needs to be augmented with "painting" noted throughout the Construction Drawings, including but not limited to the Room Finish Schedule and the Project Manual.
- B. Related Sections include the following:
 - 1. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.
 - 2. Division 06 Sections for shop priming carpentry with primers specified in this Section.
 - 3. Division 08 Sections for factory priming windows and doors with primers specified in this Section.
 - 4. Division 09 Section "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.
 - 5. Division 09 Section "High-Performance Coatings" for surface preparation and the application of paint systems on substrates in high-traffic areas.

1.3 SUBMITTALS

- A. Product Data: For paints and coatings, indicating VOC content.
- B. Laboratory Test Reports: For paints and coating, indicating compliance with requirement for low-emitting materials.
- C. Samples: For each finish and for each color and texture required provide an 8-1/2" x 11" sample for approval by Owner. Note: Allow for sufficient time in the submittal process for this review by Architect and Owner to occur without hindering the schedule.
- D. Product List: Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.4 QUALITY ASSURANCE

A. MPI Standards:

1. Products, preparation and workmanship: Complying with MPI standards indicated and listed in "MPI Approved Products List."

1.5 EXTRA MATERIALS

A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.

1. Quantity: Furnish an additional (five) 5% percent, but not less than 1 gal. f each material and color applied.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Basis-of-Design Product: The design is based on the product named in the basis-of-design and within the Construction Drawings. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified and based on substitution request approval.
- B. See Division 01 Section 012500 for "Substitution Procedures".

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are 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, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. VOC Content: For field applications, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Flat Paints and Coatings: 50 g/L.
2. Non-flat Paints and Coatings: 50 g/L.
3. Dry-Fog Coatings: 150 g/L.
4. Primers, Sealers, and Under-coaters: 100 g/L.
5. Rust-Preventative 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.

- C. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
 2. Restricted Components: Paints and coatings shall not contain any of the following:
 - a. Acrolein.
 - b. Acrylonitrile.
 - c. Antimony.
 - d. Benzene.
 - e. Butyl benzyl phthalate.
 - f. Cadmium.
 - g. Di (2-ethylhexyl) phthalate.
 - h. Di-n-butyl phthalate.
 - i. Di-n-octyl phthalate.
 - j. 1,2-dichlorobenzene.
 - k. Diethyl phthalate.
 - l. Dimethyl phthalate.
 - m. Ethylbenzene.
 - n. Formaldehyde.
 - o. Hexavalent chromium.
 - p. Isophorone.
 - q. Lead.
 - r. Mercury.
 - s. Methyl ethyl ketone.
 - t. Methyl isobutyl ketone.
 - u. Methylene chloride.
 - v. Naphthalene.
 - w. Toluene (methylbenzene).
 - x. 1,1,1-trichloroethane.
 - y. Vinyl chloride

2.3 PAINT PRODUCTS

- A. See "Interior Paint Schedule" at the end of this Section.
1. Basis-of-Design Products: Subject to compliance with requirements provide paint and accessories for a complete painting scope by Sherwin-Williams Co. and product/manufacturer listed in Schedule or by one of the following:
 - a. Benjamin Moore & Co.
 - b. Glidden Professional, (Division of PPG)
 - c. Kwal, (Division of Sherwin-Williams)
 - d. PPG Architectural Finishes, Inc.
 - e. Sherwin-Williams Co.

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 work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
- C. Percentages in five subparagraphs below are based on "MPI Architectural Painting Specification Manual."
 - 1. Gypsum Board: 12 percent.
- D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- E. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION AND APPLICATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and re-prime substrate with compatible primers as required to produce paint systems indicated.
- C. 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.
- D. 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.
- E. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

- 3.3 INTERIOR PAINT SCHEDULE (Coordinate these requirements and paint as follows, unless noted otherwise in the Finish Schedule found in the Drawings)
- A. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:
1. Mechanical Work:
 - a. Uninsulated metal piping.
 - b. Uninsulated plastic piping.
 - c. Pipe hangers and supports.
 - d. Tanks that do not have factory-applied final finishes.
 - e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 - f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
 - h. Do not paint new elevator hoist machine and related equipment.
 2. Electrical Work:
 - a. Do not paint existing switchgear.
 - b. Do not paint existing panelboards.
 - c. Do paint electrical equipment that is indicated to have a factory-primed finish for field painting.
- B. Exposed-to-View Items: The following items may or may not be specifically called out in the Room Finish Schedule or noted throughout the Construction Drawings & Project Manual but should be included as part of the painting scope of work:
1. Interior Floors:
 - a. New Concrete:
 - 1) See Division 03 Section "Cast-In-Place Concrete" for floor sealant.
 2. Interior Walls:
 - a. Gypsum wallboard:
 - 1) Latex System:
 - a) Prime Coat: Primer sealer, latex, interior, MPI X-Green #149: S-W ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils wet, 1.5 mils dry.
 - b) Intermediate Coat: Latex, interior, matching topcoat.
 - c) Topcoat: Latex, interior, eggshell, (Gloss Level 3), MPI #52 X-Green/#145 X-Green: S-W ProMar 200 Zero VOC Latex Egg-Shell, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat.
 - b. Wood Running Trim, unless designated to have a transparent-stain:

- 1) Latex System:
 - a) Prime Coat: Primer sealer, latex, interior, MPI #39: S-W Prep-Rite Pro-Block Primer Sealer, B51-620 Series, at 4.0 mils wet, 1.4 mils dry.
 - b) Intermediate Coat: Latex, interior, matching topcoat.
 - c) Topcoat: Latex, interior, eggshell, (Gloss Level 3), MPI #52 X-Green/#145 X-Green: S-W Pro-Mar 200 Zero VOC Latex Egg-Shell, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat.
3. Interior Ceilings & Soffits:
 - a. Gypsum board:
 - 1) Latex System:
 - a) Prime Coat: Primer sealer, latex, interior, MPI X-Green #149: S-W Pro-Mar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils wet, 1.5 mils dry.
 - b) Intermediate Coat: Latex, interior, matching topcoat.
 - c) Topcoat: Latex, interior, eggshell, (Gloss Level 3), MPI #52 X-Green/#145 X-Green: S-W Pro-Mar 200 Zero VOC Latex Egg-Shell, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat.
4. Interior Metal Substrates exposed-to-view (Aluminum, Steel, Galvanized Steel):
 - a. Handrails: Paint as per Section 09 9600 "High-Performance Coatings" for steel substrates, unless noted otherwise.
 - b. Guardrails: Paint as per Section 09 9600 "High-Performance Coatings" for steel substrates, unless noted otherwise.
 - c. Columns, beams and associated brackets and connections: Paint as per Section 09 9600 "High-Performance Coatings" for steel substrates, unless noted otherwise.
 - d. Stair components other than handrails and guards: Paint as per Section 09 9600 "High-Performance Coatings" for steel substrates, unless noted otherwise.
5. Interior Metal Substrates exposed-to-view (Aluminum, Steel, Galvanized Steel):
 - a. Substrates, but not limited to:
 - 1) Hollow metal doors and frames:
 - b. Latex System:
 - 1) Prime Coat: Primer, rust-inhibitive, water based, MPI #107: S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 5.0 to 10 mils wet, 2.0 to 4.0 mils dry.
 - 2) Intermediate Coat: Water-based acrylic, interior, matching topcoat.
 - 3) Topcoat: Water-based acrylic, semi-gloss, (Gloss Level 5), MPI #147 X-Green: S-W Pro Industrial Acrylic Semi-Gloss Coating, B66-650 Series, at 2.5 to 4.0 mils dry, per coat.

END OF SECTION 09 9123

SECTION 09 9600 - 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 application of high-performance coating systems on the following substrates:

- 1. Interior Substrates:

- a. Concrete, horizontal surfaces, Clear Sealant.
- b. Steel.
- c. Gypsum board.

- 2. Exterior Substrates:

- a. Steel.
- b. Wood.

- B. Related Requirements:

- 1. Section 05 1200 "Structural Steel Framing" for shop priming of metal substrates with primers specified in this Section.
- 2. Section 09 9113 "Exterior Painting" for painting of substrates not included in this section.
- 3. Section 09 9123 "Interior Painting" for painting of substrates not included in this section.

1.3 DEFINITIONS

- A. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523, an eggshell finish.
- B. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523, a semi-gloss finish.
- C. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523, a gloss finish.
- D. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523, a high-gloss finish.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include preparation requirements and application instructions.
- B. Samples for Initial Selection: For each type of topcoat product indicated.
- C. Samples for Verification: For each type of coating system and in each color and gloss of topcoat indicated.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- D. Product List: For each product indicated, include the following:
 - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 2. Printout of current "MPI Approved Products List" for each coating system specified in Part 3, with the proposed product highlighted.
 - 3. VOC content.

1.5 CLOSEOUT SUBMITTALS

- A. Coating Maintenance Manual: Provide coating maintenance manual including area summary with finish schedule, area detail designating location where each product/color/finish was used, product data pages, material safety data sheets, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

1.6 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: 5 percent, but not less than 1 gal. of each material and color applied.

1.7 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 specified in Part 3.
 - 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.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Handling: Deliver products to Project site in an undamaged condition in manufacturer's original sealed containers, complete with labels and instructions for handling, storing, unpacking, protecting, and installing. Packaging shall bear the manufacturer's label with the following information:
 1. Product name and type (description).
 2. Batch date.
 3. Color number.
 4. VOC content.
 5. Environmental handling requirements.
 6. Surface preparation requirements.
 7. Application instructions.
- B. 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.

1.9 FIELD CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and surrounding 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 GENERAL

- A. Basis-of-Design Product: The design is based on the product named in the basis-of-design and within the Construction Drawings. Subject to compliance with requirements,

provide either the named product or a comparable product by one of the other manufacturers specified and based on substitution request approval.

- B. See Division 01 Section 012500 for "Substitution Procedures".

2.2 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide The Sherwin-Williams Company; products indicated or comparable product from one of the following:
 - 1. Benjamin Moore & Co.
 - 2. PPG Architectural Finishes, Inc.
 - 3. Sherwin-Williams Co.
 - 4. Tnemec Inc.
- B. Source Limitations: Obtain paint materials from single source from single listed manufacturer.
 - 1. Manufacturer's designations listed on a separate color schedule are for color reference only and do not indicate prior approval.

2.3 HIGH-PERFORMANCE COATINGS, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and are listed in "MPI Approved Products List."
- B. Material Compatibility:
 - 1. Provide materials for use within each coating system that are 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 coating system, provide products recommended in writing by manufacturers of topcoat for use in coating system and on substrate indicated.
 - 3. Provide products of same manufacturer for each coat in a coating system.
- C. VOC Content: Utah Administrative Code R307-361 Products shall comply with VOC limits of authorities having jurisdiction and, for interior and exterior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 1. Flat Paints and Coatings: 50 g/L.
 - 2. Non-flat Paints and Coatings: 100 g/L.
 - 3. Dry-Fog Coatings: 150 g/L.
 - 4. Primers, Sealers, and Under-coaters: 100 g/L.
 - 5. Industrial maintenance Coatings Applied to Ferrous Metals: 250 g/L.
 - 6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
 - 7. Pretreatment Wash Primers: 420 g/L.
 - 8. Floor Coatings Foot Traffic: 100 g/L.
 - 9. Floor Coatings High Performance: 250 g/L.

10. Shellacs, Clear: 730 g/L.
11. Shellacs, Pigmented: 550 g/L.
12. Wood Coatings: 275 g/L.

D. Colors: As selected by Architect from manufacturer's full range.

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. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers. Where acceptability of substrate conditions is in question, apply samples and perform in-situ testing to verify compatibility, adhesion, and film integrity of new paint application.
1. Report in writing conditions that may affect application, appearance, or performance of paint.
- B. Substrate Conditions:
1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - a. Concrete: 12 percent.
 - b. Concrete Masonry: 12 percent.
 - c. Gypsum Board: 12 percent.
 2. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
 3. Plaster Substrates: Verify that plaster is fully cured.
- 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; 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 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.

- 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 re-prime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions.
 - 1. Clean surfaces with pressurized water. Use pressure range of 100 to 600 psi at 6 to 12 inches.
- F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and 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.

3.3 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
 - 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 back sides 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 will 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 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 HIGH-PERFORMANCE COATING SCHEDULE (Coordinate these requirements and paint as follows, unless noted otherwise in the Finish Schedule found in the Drawings.)

- A. Schedule:
 1. Interior:
 - a. Columns, beams and associated brackets and connections, exposed-to-view.
 2. Exterior:
 - a. Handrails.
 - b. Guardrails.
 - c. Columns, beams and associated brackets and connections, exposed-to-view.
 - d. Hollow Metal Doors and Frames.
- B. Interior Substrates:
 1. Steel (Ferrous Metals) Substrates: (When exposed to view)
 - a. Epoxy-Modified Latex System:
 - 1) Prime Coat: Primer, rust-inhibitive, water based, MPI #107: S-W Pro-Cryl Universal Primer, B66-310 Series, at 2.0 to 4.0 mils dry, per coat.
 - 2) Intermediate Coat: Epoxy-modified latex, interior, gloss matching topcoat.

- 3) Topcoat: Epoxy-modified latex, interior, eggshell, (Gloss Level 3), MPI #254/MPI #254X-Green: S-W Pro Industrial Water-based Catalyzed Epoxy Eggshell, B73-300 Series, at 2.0 to 4.0 mils dry, per coat.
2. Gypsum Board Substrates:
 - a. Epoxy-Modified Latex System:
 - 1) Prime Coat: Primer sealer, latex, interior, MPI X-Green #149X: S-W ProMar 200 Zero VOC Interior Latex Primer, B28 Series, at 1.0 mils dry, per coat.
 - 2) Intermediate Coat: Epoxy-modified latex, interior, matching topcoat.
 - 3) Topcoat: Epoxy-modified latex, interior, eggshell, (Gloss Level 3), MPI #115/#115X-Green: S-W Pro Industrial Water-based Catalyzed Epoxy Eggshell, B73-360 Series, at 2.0 to 4.0 mils dry, per coat.
- C. Exterior Substrates:
1. Steel (Ferrous Metals) Substrates: (When exposed to view)
 - a. Pigmented Polyurethane over Epoxy System with shop-coat primer:
 - 1) Prime Coat: Primer, rust-inhibitive, water based, MPI #107: S-W S-W Pro-Cryl Universal Primer, B66-310 Series, at 2.0 to 4.0 mils dry, per coat.
 - 2) Intermediate Coat: Epoxy, high-build, low gloss, : S-W Macropoxy 646-100, B58-600 Series, B-73-620 Series, at 5 to 10 mils dry, per coat.
 - 3) Topcoat: Polyurethane, two-component, pigmented, gloss, (Gloss Level 6): S-W Water-based Acrolon 100 Polyurethane, B65-720 Series, at 2.0 to 4.0 mils dry, per coat.
 2. Galvanized Metal and Aluminum Substrates: (When exposed to view)
 - a. Water-based Light Industrial Coating System:
 - 1) Prime Coat: Primer, water-based, anti-corrosive for metal, MPI #107: S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, 5.0 to 10.0 mils wet, 2.0 to 4.0 mils dry.
 - 2) Prime Coat: Shop primer specified in Section where substrate is specified.
 - 3) Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
 - 4) Topcoat: Light industrial coating, exterior, water based, semi-gloss, (Gloss Level 5), MPI #163: S-W Pro Industrial Acrylic Semi-Gloss Coating, B66-650 Series, at 2.5 to 4.0 mils dry, per coat.

END OF SECTION 09 9600

SECTION 099656 – EPOXY FLOOR COATINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes: Provide a complete epoxy floor system for concrete surfaces located in the Apparatus Bay that meet the requirements for specific use indicated in the contract documents. Include all applicable substrate testing, surface preparation, and detail work.

1.2 RELATED SECTIONS

- A. Section 03 3000 – Cast-In-Place Concrete
- B. Section 09 0000 - Finishes

1.3 SUBMITTALS

- A. Submit under provisions of Section 013300.
- B. Product Data: Submit manufacturer's product data sheets on each product and system to be used including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements.
 - 3. Installation methods.
 - 4. Maintenance requirements.
- C. Selection Samples: For each system specified, provide two sets of samples and color charts, representing manufacturer's full range of colors and patterns.

1.4 QUALITY ASSURANCE

- A. All materials used in the epoxy floor system shall be manufactured and provided by a single manufacturer to ensure compatibility and proper bonding.
- B. Use adequate numbers of skilled workmen thoroughly trained and experienced in the necessary crafts and completely familiar with the specified requirements and methods needed for proper performance of the work of this section.
- C. Contractor shall have a minimum of 3 years experience installing epoxy floor coatings similar to that which is required for this project and who is acceptable to the manufacturer.
 - 1. Applicator shall designate a single individual as project foreman who shall be on site at all times during installation.

2. Contractor must show and have QCA Qualified Contractor/Applicator paperwork from the manufacturer of the coating system, as required to obtain a long-term jobsite specific warranty.
- D. Convene a pre-application meeting before the start of application of coating system. Require attendance of parties directly affecting work of this section, including: Architect, contractor, applicator, and authorized representative of the coating system manufacturer and interfacing trades. Review the following:
1. Drawings and specifications affecting work of this section.
 2. Protection of adjacent surfaces.
 3. Surface preparation and substrate conditions.
 4. Application.
 5. Field quality control.
 6. Protection of coating system.
 7. Repair of coating system.
 8. Coordination with other work.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Materials shall be delivered to the job site in sealed, undamaged containers. Each container shall be clearly marked with manufacturer's label showing type of material, color, and lot number.
- B. Storage: Store all materials in a clean, dry place with a temperature range in accordance with manufacturer's instructions.
- C. Handling: Handle products carefully to avoid damage to the containers. Read all labels and Material Safety Data Sheets prior to use.

1.6 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within the limits recommended by the manufacturer.
- B. Concrete shall be tested for moisture before applying seamless coating. Water vapor transmission upwards through on-grade concrete slabs may result in loosening of epoxy floors or improper curing of epoxy materials. If moisture emissions exceed 5 pounds per 1,000 square feet contact the manufacturer before application.
- C. Concrete must be at least 2500 psi and feel like 30 or 50 grit sandpaper.
- D. Concrete must be cured for a minimum of 28 days before coating is applied.
- E. Schedule coating work to avoid excessive dust and airborne contaminants. Protect work areas from excessive dust and airborne contaminants during coating application.
- F. Before any work is started, the applicator shall examine all surfaces for any deficiencies. Should any deficiencies exist, the architect, owner and general contractor shall be notified in writing and any corrections necessary shall be made.

1.7 WARRANTY

- A. Upon completion of the work in this section provide a written warranty from the manufacturer against defects or materials for a period of 1 (one) year. To obtain project specific warranty the coating system applicator must be a Westcoat Qualified Contractor/Applicator and apply for warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. BASIS OF DESIGN: Acceptable manufacturer: Westcoat Specialty Coatings; 770 Gateway Center Drive, San Diego, CA 92102. Telephone 800-250-4519. Fax 619-262-8606. Web Site: www.westcoat.com.
- B. Submit Epoxy Floor Coating substitutions for review by Architect prior to bid opening.

2.2 MATERIALS

- A. As basis of design Westcoat Dubro Quartz System: 100% solids double broadcast epoxy floor coating system with quartz sand broadcasted into the clear base coat and sealed with clear epoxy.

2.3 COMPONENTS

- A. Dubro Quartz System: 100% Solids Double Quartz Broadcast Epoxy.
 1. Primer: EC-12 Epoxy Primer 250-300 square feet per gallon.
 2. Base Coat: EC-32 Clear Epoxy Topcoat 125-150 square feet per gallon.
 3. Broadcast TC-65 Quartz Sand aggregate 100 square feet per 50 pounds.
 4. Second Coat: EC-32 Clear Epoxy Topcoat 75-100 square feet per gallon.
 5. Broadcast TC-65 Quartz Sand aggregate 100 square feet per gallon.
 6. Top Coat: EC-32 Clear Epoxy Topcoat 100-150 square feet per gallon.
 7. Optional Second Top Coat: EC-31 Epoxy Clear Topcoat or EC-95 Polyurethane Topcoat 200-400 square feet per gallon.
 8. Submit manufacturers full range of colors for Architects' selection.

2.4 ACCESSORIES

- A. Supplemental Materials:
 1. Patching materials shall be EC-72 epoxy gel or TC-5 Concrete Patch.
 2. Optional cove base shall be EC-76 Epoxy Cove Gel.
 3. Optional aggregate shall be CA-30 Safe Grip, or TC-65 Quartz Sand to meet the owners skid resistance requirements.
 4. Radius cove base with CA-53 cove cap.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions.
 - 1. Inspect all surfaces to receive epoxy flooring. Verify that surfaces are dry, clean, and free of contaminants that would prevent epoxy flooring from properly adhering to the surface.
 - 2. Conduct calcium chloride testing according to ASTM F1869.
 - 3. Conduct surface profile inspection according to ICRI Technical Guideline No. 03732.
 - 4. Before starting work, report in writing to the authority having jurisdiction any unsatisfactory conditions.

3.2 SURFACE PREPARATION

- A. Prepare surfaces using methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- B. Create a surface profile by shot blasting or mechanically abrading the surface.
- C. Clean surfaces thoroughly prior to installation.
- D. Rout and clean moving cracks and joints: fill with manufacturer's recommended flexible epoxy filler material.
- E. Repair any non-moving surface deviations with manufacturer's recommended patching material.

3.3 INSTALLATION

- A. Install coatings in accordance with manufacturer's instructions.
- B. Mix multi-component materials in accordance with manufacturer's instructions.
- C. Use application equipment, tools, and techniques in accordance with manufacturer's instructions.
- D. Uniformly apply coatings at spread rates and in number of coats to achieve specified mil thickness recommended by the manufacturer.
 - 1. Install integral cove base where indicated on the contract drawings and according to manufacturer's instructions.
 - 2. Key in all drains, edges, and transition points according to manufacturer's instructions.
- E. Broadcast aggregates to all limitations, instructions, and cautions for epoxy coating as stated in the manufacturer's published literature.

- F. Adhere to all limitations, instructions, and cautions for epoxy coating as stated in the manufacturer's published literature.

3.4 FIELD QUALITY CONTROL

- A. Verify coatings and other materials are as specified.
- B. Verify coverages of the system as work progresses. Areas found not to meet the required thickness shall receive additional material until specified thickness is attained.
- C. Manufacturer's representative shall provide technical assistance and guidance for surface preparation and application of coating systems.

3.5 CLEANING AND PROTECTING

- A. Installation areas must be kept free from traffic and other trades during the application procedure and cure time.
- B. Protect finished surfaces of coating system from damage during construction.
- C. Touch-up, repair or replace damaged flooring system after substantial completion.
- D. Clean area and remove all debris upon completion of work. Dispose of empty containers properly according to current Local, State and Federal regulations.

3.6 MAINTENANCE

- A. Contractor shall provide to owner, maintenance and cleaning instruction for the floor system upon completion of work. Owner is required to clean and maintain the surfaces to maintain manufacturer's warranty.

END OF SECTION 096566

SECTION 09 9726 - CEMENTITIOUS 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 application of cementitious coating systems on the following substrates:
 - 1. Interior concrete.
- B. Related Sections:
 - 1. Section 03 3000 "Cast-In-Place Concrete" for substrate.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: In each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, not less than 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.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each cementitious coating, from manufacturer.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency or performed by a qualified testing agency, for each product formulation.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that are from same production run (batch mix) as materials applied and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Quantity: Furnish an additional 5 percent of each color applied.

1.6 QUALITY ASSURANCE

- A. Installation should be carried out by a "basis-of-design" certified installer or a preferred contractor with a documented quality assurance note. Obtain details of a preferred contractor network from the customer service team or by enquiring through website of the "basis-of-design".
- B. Mockups: Apply mockups of coating 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 actual substrate of each type to represent surfaces and conditions for application of coating.
 - 2. Apply mockups after permanent lighting and other environmental services have been activated.
 - 3. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of colors selected by Architect at no added cost to Owner.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, new, unopened packages and containers bearing manufacturer's name and label, and the following information:
 - 1. Product name or title of material.
 - 2. Manufacturer's stock number and date of manufacture.
 - 3. Contents by volume, for pigment and vehicle constituents.
 - 4. Application instructions.
 - 5. Color name and number.
 - 6. Handling instructions and precautions.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain containers used in storage of coatings in a clean condition, free of foreign materials and residue.
 - 1. Protect cementitious coating materials from freezing. Keep materials dry and storage area neat and orderly. Remove waste daily. Take necessary measures to ensure that workers and work areas are protected from health hazards resulting from handling, mixing, and applying the coating.

1.8 FIELD CONDITIONS

- A. Apply coatings only when temperature of surfaces to be painted 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.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Basis-of-Design Product: The design is based on the product named in the basis-of-design and within the Construction Drawings. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified and based on substitution request approval.
- B. See Div 01 Section 01 2500 for "Substitution Procedures".

2.2 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Flowcrete Americas; Flowfresh TZ, or a comparable product by one of the following:
 - 1. BASF Corporation; Construction Systems.
 - 2. Bonsal American, an Oldcastle company.
 - 3. Euclid Chemical Company (The); an RPM company.
 - 4. Silpro Corporation.
- B. Flowcrete Americas
616 Spring Hill Drive, suite 100
Spring, Tx 77386
Phone: 1-936-539-6700
<http://www.flowcreteamericas.com>
- C. Source Limitations: Obtain cementitious coating materials from single source and from single manufacturer.

2.3 CEMENTITIOUS COATINGS

- A. Polymer-Modified Cementitious Coating: A decorative, slurry-broadcast and HACCP International certified antimicrobial treated cementitious urethane floor system.
- B. System Physical Properties:
 - 1. Compressive Strength: Not less than 8,128 psi at 28 days according to ASTM C 579.
 - 2. Tensile Strength: Not less than 1,450 psi at 28 days according to ASTM C 307.
 - 3. Flexural Strength: 2,900 psi according to ASTM C 580.
 - 4. Adhesion: 400 PSI according to ASTM D 2047.
 - 5. Coefficient of Thermal Expansion: 1.5×10^{-5} in/in/°F.
 - 6. Coefficient of Friction: According to ASTM D 2047 (Exceeds ADA recommendations).
- A. VOC Content: Utah Administrative Code R307-361 Products shall comply with VOC limits of authorities having jurisdiction and, for interior and exterior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1. Flat Paints and Coatings: 50 g/L.
2. Non-flat Paints and Coatings: 100 g/L.
3. Dry-Fog Coatings: 150 g/L.
4. Primers, Sealers, and Under-coaters: 100 g/L.
5. Industrial maintenance Coatings Applied to Ferrous Metals: 250 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Floor Coatings Foot Traffic: 100 g/L.
9. Floor Coatings High Performance: 250 g/L.

- B. Colors: As selected from Manufacturers full range of colors by Architect.
- C. Other Materials: Provide crack fillers, block fillers, and related materials that are compatible with cementitious finish-coat materials and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

2.4 MISCELLANEOUS MATERIALS

- A. Transitions Strips:
1. Basis-of-Design: Schluter-RENO-U, EBU 80.
 - a. Finish: Brushed stainless steel 304.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Verify suitability of substrates, including surface conditions and compatibility.
- C. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for mixing and preparing materials and as applicable to substrates indicated.
- B. Remove plates, machined surfaces, and similar items already in place that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.

1. After completing coating operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of coatings, including dirt, oil, grease, incompatible coatings, and loose substrate materials.
- D. Cementitious and Masonry Surfaces: 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. Crack Repair: Fill cracks according to manufacturer's written instructions before coating surfaces.
 1. Cracks Larger Than 1/32 Inch: Cut out static cracks, voids, or honeycombing larger than 1/32 inch and patch with materials recommended in writing by coating manufacturer. Identify dynamic cracks and treat according to manufacturer's written instructions before beginning application.

3.3 APPLICATION

- A. Apply coatings according to manufacturer's written instructions. Use applicators and techniques suited for coating and substrate indicated.
 1. Dampen substrate of surfaces to receive cementitious coatings one hour before beginning application to prevent surface drag. Immediately before applying coatings, re-dampen substrate. Substrates shall be saturated and surface dry at time of application.
 2. Brushes: Use Tampico or masonry brushes best suited for material being applied.
 3. Spray Equipment: Use spray equipment recommended in writing by manufacturer for material and texture required.
- B. Apply coating to achieve material thickness as recommended in writing by manufacturer, but not less than the following:
 1. First Coat: Apply polymer-modified cementitious coating material at the rate of 2 lb/sq. yd. to achieve a total cured thickness of 25 mils.
 2. Second Coat: Apply polymer-modified cementitious coating material at the rate of 1 lb/sq. yd. to achieve a total cured thickness of 15 mils.
 3. Apply additional coats when undercoats or other conditions show through final coat until cured film is of uniform coating finish, color, and appearance.
- C. On previously coated surfaces, apply coating to achieve material thickness as recommended in writing by manufacturer, but not less than the following:
 1. Apply polymer-modified cementitious coating material at the rate of 1 lb/sq. yd. to achieve a total cured thickness of 15 mils.
 2. Apply additional coats when undercoats or other conditions show through final coat until cured film is of uniform coating finish, color, and appearance.
- D. Brush Application: Brush out and work brush coats into surfaces in an even film, filling all pores and voids at rate recommended in writing by manufacturer to achieve cured material thickness indicated. Finish coat with smooth, horizontal strokes.

- E. Spray Application: Apply each coat according to manufacturer's written instructions to provide the equivalent hiding of brush-applied coats. Follow spray application with a general light brooming of coated surface to impart a slight texture.

3.4 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 application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.5 CEMENTITIOUS COATING SCHEDULE

- A. Above-Grade Concrete:
 - 1. Polymer-Modified Cementitious Coating:
 - a. Prime Coat: As recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - c. Topcoat: Polymer-modified cementitious coating.
 - 1) See "Basis-of-Design" Product.

END OF SECTION 09 9726

SECTION 10 1400 - SIGNAGE

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. Cast Plaques.
- 2. Dimensional characters for building address numbers.
- 3. Panel signs.

- B. Related Sections include the following:

- 1. Division 22 Section "Identification for Plumbing Piping and Equipment for labels, tags, and nameplates for plumbing systems and equipment.
- 2. Division 26 Sections for electrical service and connections for illuminated signs.
- 3. Division 26 Section "Identification for Electrical Systems" for labels, tags, and nameplates for electrical equipment.
- 4. Division 26 Section "Interior Lighting" for illuminated Exit signs.

1.3 DEFINITIONS

- A. ADA-ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines."

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. Shop Drawings: Show fabrication and installation details for signs.

- 1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
- 2. Provide message list, typestyles, graphic elements, including tactile characters and Braille, and layout for each sign.
- 3. Wiring Diagrams: Power, signal, and control wiring.

- C. Samples for Initial Selection: Manufacturer's color charts consisting of actual units or sections of units showing the full range of colors available for the following:

1. Aluminum.
 2. Acrylic sheet.
 3. Fiberglass sheet.
 4. Die-cut vinyl characters and graphic symbols. Include representative samples of available typestyles and graphic symbols.
- D. Samples for Verification: For each of the following products and for the full range of color, texture, and sign material indicated, of sizes indicated:
1. Dimensional Characters: Full-size Samples of each type of dimensional character (letter, number, and graphic element).
 2. Aluminum: For each form, finish, and color, on 6-inch-long sections of extrusions and squares of sheet at least 4 by 4 inches.
 3. Acrylic Sheet: 8 by 10 inches for each color required.
 4. Fiberglass Sheet: 8 by 10 inches for each color required.
 5. Panel Signs: Not less than 12 inches square including border.
 6. Accessories: Manufacturer's full-size unit.
- E. Sign Schedule: Use same designations indicated on Drawings.
- 1.5 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For signs to include in maintenance manuals.
- 1.6 QUALITY ASSURANCE
- A. Installer Qualifications: [Fabricator of products] [An employer of workers trained and approved by manufacturer] <Insert requirements>.
- B. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- C. Source Limitations for Signs: Obtain each sign type indicated from one source from a single manufacturer.
- D. Regulatory Requirements: Comply with applicable provisions in ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- 1.7 PROJECT CONDITIONS
- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit installation of signs in exterior locations to be performed according to manufacturers' written instructions and warranty requirements.

- B. Field Measurements: Verify recess openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 COORDINATION

- A. Coordinate placement of anchorage devices with templates for installing signs.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of metal and polymer finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image colors and sign lamination.
 - 2. Warranty Period: One-year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum Castings: ASTM B 26/B 26M, of alloy and temper recommended by sign manufacturer for casting process used and for use and finish indicated.
- B. Aluminum Sheet and Plate: ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with at least the strength and durability properties of Alloy 5005-H32.
- C. Bronze Castings: ASTM B 584, Alloy UNS No. C86500 (No. 1 manganese bronze).
- D. Bronze Plate: ASTM B 36/B 36M.
- E. Fiberglass Sheet: Molded, seamless, thermosetting, glass-fiber-reinforced polyester panels with a minimum tensile strength of 15,000 psi when tested according to ASTM D 638 and with a minimum flexural strength of 30,000 psi when tested according to ASTM D 790.
- F. Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), Type UVA (UV absorbing).
- G. Polycarbonate Sheet: Of thickness indicated, manufactured by extrusion process, coated on both surfaces with abrasion-resistant coating:
 - 1. Impact Resistance: 16 ft-lbf/in. per ASTM D 256, Method A.
 - 2. Tensile Strength: 9000 lbf/sq. in. per ASTM D 638.
 - 3. Flexural Modulus of Elasticity: 340,000 lbf/sq. in. per ASTM D 790.
 - 4. Heat Deflection: 265 deg F at 264 lbf/sq. in. per ASTM D 648.

5. Abrasion Resistance: 1.5 percent maximum haze increase for 100 revolutions of a Taber abraser with a load of 500 g per ASTM D 1044.
- H. Applied Vinyl: Die-cut characters from vinyl film of nominal thickness of 3 mils with pressure-sensitive adhesive backing, suitable for exterior applications.

2.2 APPROVED MANUFACTURERS

- A. 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:
 1. Fastsigns, (801)261-3000
 2. Identity Signs, Cindy Gooch (801) 748-4750.
 3. The Signsmith, Wendi Larsen (801) 518-2826.

2.3 PLAQUES

- A. Cast Plaque: Plaque with background texture, border, and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
 1. Gemini Letters and Signs.
 2. Plaque Material: Cast aluminum.
 3. Plaque Thickness: 0.25 inch0.50 inch (manufacturer's standard thickness).
 4. Color: Custom color as selected by architect from manufacturer's full range of colors.
 5. Finishes: Polished finish (+40%).
 6. Background Texture: Leatherette.
 7. Integrally Cast Border Style: Square single line, polished, .375" wide.
 8. Mounting: Type A - blind mount.
 9. Text and Typeface: Typeface and text matching elevation detail in the drawings.
 10. Size: See elevation in the drawings.

2.4 PANEL SIGNS

- A. Interior Panel Signs: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner, complying with the following requirements:
 1. Aluminum Sheet: 0.080 inch.
 2. Acrylic Sheet: 0.080 inchthick.
 3. Phenolic-Backed Photopolymer Sheet: Provide light-sensitive, water-wash photopolymer face layer bonded to a phenolic base layer to produce a composite sheet with overall, face layer, and base-layer thicknesses, respectively, of 0.120, 0.040, and 0.080 inch.
 4. Laminated Sheet: High-pressure engraved stock with face laminated to acrylic core as selected by Architect from manufacturer's full range.

5. Laminated, Sandblasted Polymer: Raised graphics with Braille 1/32 inch above surface with contrasting colors as selected by Architect from manufacturer's full range and laminated to acrylic back.
 6. Edge Condition: Square cut.
 7. Corner Condition: Square or rounded to radius indicated. See signage details.
 8. Mounting: As indicated.
 - a. Manufacturer's standard anchors for substrates encountered.
 9. Color: As selected by Architect from manufacturer's full range.
 10. Tactile Characters: Characters and Grade 2 Braille raised 1/32 inch above surface with contrasting colors.
- B. Exterior Signs and Insignia: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner, complying with the following requirements:
1. Powder Coated finish over 1/4inch thick steel.
 2. Attached to substrate with stainless steel countersink fasteners sufficient in length to provide solid connection to primary structural framing.
 3. Stainless Steel spacers located and thickness as indicated on project detail.
- C. Laminated Interior/Exterior Signs: Solid phenolic panel core with graphic image covered with thermosetting resin face layer.
1. Surface Finish: Mat, Gloss or UV resistant, outdoor. Coordinate with Architect.
 2. Edge Condition: Square cut.
 3. Corner Condition: Square or rounded to radius indicated. See signage details.
 4. Thickness: 1/4 inch.
- D. Brackets: Fabricate brackets and fittings for bracket-mounted signs from extruded aluminum to suit panel sign construction and mounting conditions indicated. Factory paint brackets in color matching Architect's sample.
- E. Tactile and Braille Sign: Manufacturer's standard process for producing text and symbols complying with ADA-ABA Accessibility Guidelines and with ICC/ANSI A117.1. Text shall be accompanied by Grade 2 Braille. Produce precisely formed characters with square-cut edges free from burrs and cut marks; Braille dots with domed or rounded shape.
1. Panel Material: Opaque acrylic sheet.
 2. Raised-Copy Thickness: Not less than 1/32 inch.
- F. Subsurface Copy: Apply minimum 4-mil-thick vinyl copy to back face of clear acrylic sheet forming panel face to produce precisely formed opaque image. Image shall be free of rough edges.
- G. Applied Vinyl: Die-cut characters from vinyl film of nominal thickness of 3 mils with pressure-sensitive adhesive backing. Apply copy to exposed face of panel sign. Note: Some vinyl will be reflective. See signage details.

1. Panel Material: Clear acrylic sheet with opaque color coating, subsurface applied.
- H. Colored Coatings for Acrylic Sheet: For copy and background colors, provide colored coatings, including inks, dyes, and paints, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and are UV and water resistant for five years for application intended.
1. Color: As selected by Architect from manufacturer's full range.
- I. Panel Sign Schedule:
1. Sign Type: See signage details and schedule in construction documents.
 - a. Sign Size: As indicated.
 - b. Message Panel Material: As indicated.
 - c. Message Panel Finish/Color: As selected by the Architect from the paint manufacturer's full range of colors.
 - d. Background Finish/Color: As selected by the Architect from the paint manufacturer's full range of colors and sheens.
 - e. Character Size: As indicated.
 - f. Character Finish/Color: As selected by the Architect from the paint manufacturer's full range of colors and sheens.
 - g. Text/Message: As indicated.
 - h. Location: As indicated.
 - i. Room: As indicated.
 - j. Quantity: As indicated.

2.5 ACCESSORIES

- A. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

2.6 FABRICATION

- A. General: Provide manufacturer's standard signs of configurations indicated.
1. Welded Connections: Comply with AWS standards for recommended practices in shop welding. Provide welds behind finished surfaces without distortion or discoloration of exposed side. Clean exposed welded surfaces of welding flux and dress exposed and contact surfaces.
 2. Mill joints to tight, hairline fit. Form joints exposed to weather to exclude water penetration.
 3. Preassemble signs in the shop to greatest extent possible. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in location not exposed to view after final assembly.
 4. Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.

2.7 FINISHES, GENERAL

- 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: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 ALUMINUM FINISHES

- A. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.
 - 1. Organic Coating: Thermosetting, modified-acrylic enamel primer/topcoat system complying with AAMA 2603 except with a minimum dry film thickness of 1.5 mils, medium gloss.

2.9 ACRYLIC SHEET FINISHES

- A. Colored Coatings for Acrylic Sheet: For copy and background colors, provide colored coatings, including inks, dyes, and paints, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and that are UV and water resistant for five years for application intended.

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 work.
- B. Verify that items, including anchor inserts, are sized and located to accommodate signs.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Locate signs and accessories where indicated, using mounting methods of types described and complying with manufacturer's written instructions.
 - 1. Install signs level, plumb, and at heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches of sign without encountering protruding objects or standing within swing of door.
- B. Wall-Mounted Signs: Comply with sign manufacturer's written instructions except where more stringent requirements apply.
 - 1. Two-Face Tape: Mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.
 - 2. Silicone-Adhesive Mounting: Attach signs to irregular, porous, or vinyl-covered surfaces.
 - 3. Shim Plate Mounting: Provide 1/8-inch-thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other mounting methods are not practicable. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach panel signs to plate using method specified above.
 - 4. Mechanical Fasteners: Use nonremovable mechanical fasteners placed through predrilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.
- C. Bracket-Mounted Signs: Provide manufacturer's standard brackets, fittings, and hardware for mounting signs that project at right angles from walls and ceilings. Attach brackets and fittings securely to walls and ceilings with concealed fasteners and anchoring devices to comply with manufacturer's written instructions.
- D. Dimensional Characters: Mount characters using standard fastening methods to comply with manufacturer's written instructions for character form, type of mounting, wall construction, and condition of exposure indicated. Provide heavy paper template to establish character spacing and to locate holes for fasteners.
 - 1. Flush Mounting: Mount characters with backs in contact with wall surface. See signage details.
 - 2. Projected Mounting: Mount characters at projection distance from wall surface indicated. Only in areas where a person cannot access. See signage details.

3.3 CLEANING AND PROTECTION

- A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.

END OF SECTION 10 1400

SECTION 10 2800 – TOILET AND BATH 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. Occupant washroom accessories.
- 2. Under-lavatory guards.

- B. Related Sections:

- 1. Division 09 Section "Tiling" for ceramic toilet and bath accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:

- 1. Construction details and dimensions.
- 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
- 3. Material and finish descriptions.
- 4. Features that will be included for Project.
- 5. Manufacturer's warranty.

- 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 products using designations indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Warranty: Provide standard product/manufacturer warranties per basis-of-design products listed in the Legend.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.
- 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.

1.7 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.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.
- E. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- F. 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.
- G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.
- I. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated:
- B. Toilet Tissue (Roll) Dispenser:
 - 1. Basis-of-Design Product: Bradley; Model 5123; Recessed, Stainless Steel, Dual Roll.
- C. Paper Towel Dispenser:
 - 1. Basis-of-Design Product: Bradley; Model 2447; Recessed; Stainless Steel.
- D. Liquid-Soap Dispenser:
 - 1. Basis-of-Design Product: Bradley; Model 6562; Surface Mounted; Stainless Steel.
- E. Napkin Disposal:
 - 1. Basis-of-Design Product: Bradley; Model 4781-11; Surface Mounted, Stainless Steel.
- F. Grab Bar:
 - 1. Basis-of-Design Product: Bradley; Model 832; stainless steel.18", 24" 36" 42" long bars as per ADA requirements as noted in the drawings.
- G. Channel Frame Mirror:
 - 1. Basis-of-Design Product: Bradley; Model 781; Surface Mounted, Stainless Steel Frame, 24inch x 36inch
- H. Mop/Utility Shelf:
 - 1. Basis-of-Design Product: Bradley; Model 9933; Surface Mounted, Stainless Steel, 4 Hooks and 3 Holders
- I. Robe Hook:
 - 1. Basis-of-Design Product: Bradley; Model 9114 Bradex, Surface Mounted, stainless steel. Provide as indicated on drawings.
- J. Shelf:
 - 1. Basis-of-Design Product: Bradley; Model 755-12, Surface Mounted, Stainless Steel.
- K. Shower Curtain, Hooks and Rod:
 - 1. Basis-of-Design Product: Bradley; Model 9533, 9536 and 9539 respectively, Stainless Steel. Quantities and dimensions for these products shall be verified in the field.

2.3 UNDERLAVATORY GUARDS

- A. 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:
 - 1. Plumberex Specialty Products, Inc.
 - 2. Truebro by IPS Corporation.
- B. Underlavatory Guard:
 - 1. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
 - 2. Material and Finish: Antimicrobial, molded plastic, white.

2.4 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 F 446.

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 recommendations.

END OF SECTION 10 2800

SECTION 10 4413 - FIRE EXTINGUISHER CABINETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes fire protection cabinets for fire extinguishers.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Maintenance data.

1.3 QUALITY ASSURANCE

- A. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.
- B. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- C. Coordinate sizes and locations of fire protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
- B. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.2 FIRE PROTECTION CABINET (FE#, see Schedule at the end of this section):

- A. Cabinet Type: Suitable for fire extinguisher.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide Larsen's Manufacturing Company Construction Products Group;

- 1) Type: Model FS 2712-RL Architectural Style.
 - 2) Cabinet Material: Cold-rolled Steel with Powder-coat Finish
 - 3) Tub Material: Cold-rolled Steel with Powder-coat Finish
 - 4) Mounting: Semi-recessed
 - 5) Glazing: Full Tempered Glass
 - 6) Fire Rated Option: Yes, in locations noted on drawings.
2. or a comparable product by one of the following:
- a. Fire End & Croker Corporation;
 - b. Kidde Residential and Commercial Division, Subsidiary of Kidde plc;
 - c. Modern Metal Products, Division of Technico Inc.;
 - d. Potter Roemer LLC.
 - e. J.L. Industries, Inc.
- B. Cabinet Construction: Nonrated and Fire Rated.
1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.0428-inch thick, cold-rolled steel sheet lined with minimum 5/8-inch thick, fire-barrier material. Provide factory-drilled mounting holes. See drawing for fire rated locations
- C. Cabinet Material: Steel sheet.
- D. Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim indicated.
1. Trimless with Concealed Flange: Surface of surrounding wall finishes flush with exterior finished surface of cabinet frame and door, without overlapping trim attached to cabinet. Provide recessed flange, of same material as box, attached to box to act as [plaster stop] [drywall bead].
 2. Trimless with Hidden Flange: Flange of same metal and finish as box overlaps surrounding wall finish and is concealed from view by an overlapping door.
 3. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
- E. Semi-recessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semi-recessed cabinet installation.
1. Rolled-Edge Trim: 2-1/2-inch or 3-inch backbend depth.
- F. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim. Provide where walls are of insufficient depth for semi-recessed cabinet installation.
- G. Cabinet Trim Material: Steel sheet, same material and finish as door.
- H. Door Material: Steel sheet.

- I. Door Style: Fully glazed panel with frame.
- J. Door Glazing: Tempered float glass (clear).
- K. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
- L. 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. Break-Glass Strike: Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.
 - 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 indicated.
 - a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."
 - 1) Location: Applied to cabinet door glazing.
 - 2) Application Process: Decals or Pressure-sensitive vinyl letters.
 - 3) Lettering Color: Black.
 - 4) Orientation: Vertical.
- M. Finishes:
 - 1. Manufacturer's standard baked-enamel paint for the following:
 - a. Exterior of cabinet door, and trim, except for those surfaces indicated to receive another finish.
 - b. Interior of cabinet and door.
 - 2. Steel: Baked enamel or powder coat.
 - a. Color and Gloss: White or Red.

2.3 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. Miter and weld joints and grind smooth.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine walls and partitions for suitable framing depth and blocking where semi-recessed cabinets will be installed and prepare recesses as required by type and size of cabinet and trim style.
- B. Install fire protection cabinets in locations and at mounting heights indicated and at heights acceptable to authorities having jurisdiction.
- C. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.
- D. Identification: Apply decals or vinyl lettering at locations indicated.
- E. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- F. 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 10 4413

SECTION 10 4416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and maintenance data.
- C. Warranty: Sample of special warranty.

1.3 QUALITY ASSURANCE

- 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.

1.4 WARRANTY

- A. Fire Extinguishers 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. Warranty Period: 6 (Six) years from date of shipment.

PART 2 - PRODUCTS

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each indicated on the 'Code Analysis' Floor Plan Sheets provided by one of the manufacturers listed below.
 - 1. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.

- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
- a. Ansul Incorporated; Tyco International Ltd.
 - b. J. L. Industries, Inc.; a division of Activar Construction Products Group.
 - c. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
 - d. Larsen's Manufacturing Company.
1. If not noted otherwise provide the following fire extinguisher type and capacity: Multipurpose dry-chemical type in steel container UL-rated 4-A:60-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.2 MOUNTING BRACKETS AND CABINETS

- 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 red or black baked-enamel finish.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine fire extinguishers for proper charging and tagging.
1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
1. Mounting Brackets: 54 inches above finished floor to top of fire extinguisher.
- C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 10 4416

SECTION 10 5113 - METAL LOCKERS

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. Open-front turnout lockers.
- B. Related Section:
 - 1. Section 12 3200 "Manufactured Casework" for lockers.
 - 2. Concrete or masonry bases, wood furring, blocking or trim as may be required by drawings are included in other sections of this specification.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker.
 - 1. Color Charts: Provide color charts showing manufacturer's available colors.
- B. Shop Drawings: For metal lockers. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show locker trim and accessories.
 - 2. Include locker identification system and numbering sequence.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Warranty: Sample of manufacturer's warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain metal lockers and accessories from single source from single manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of recessed openings by field measurements before fabrication.

1.9 COORDINATION

- A. Coordinate sizes and locations of concrete bases for metal lockers.
- B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.10 WARRANTY

- A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.
 - 1. Failures include, but are not limited to , the following:
 - a. Structural failures.
 - b. Faulty operation of latches and other door hardware.
 - 2. Damage from deliberate destruction and vandalism is excluded.
 - 3. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.

- B. Expanded Metal: ASTM F 1267, Type II (flattened), Class I, 3/4-inch steel mesh, with at least 70 percent open area.
- C. Stainless-Steel Sheet: ASTM A 666, Type 304. Retain first four paragraphs below for locker benches if required.
- D. Steel Tube: ASTM A 500, cold rolled.
- E. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.
- F. Anchors: Material, type, and size required for secure anchorage to each substrate.
 - 1. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.2 OPEN-FRONT TURN-OUT ROOM METAL LOCKERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Emergency Response Turnout Locker, by Ready Rack, or comparable product by one of the following:
- B. Type: Single-Tier Units.
- C. Quantity: See drawings for quantity.
- D. Size: 24 inches wide x 20 inches deep x 72 inches high, unless otherwise indicated on the Drawings.
- E. Locker Arrangement: Open front, Adjustable boot and helmet shelf, hanging pole, floor system, two Hangers and two side clips for each unit.
- F. Mounting: Wall Mounted. Provide adequate wood blocking in order to provide a positive attachment of the lockers to the scheduled wall type.
- G. Material: Cold-rolled steel sheet.
- H. Construction: Lockers shall be pre-assembled of welded construction conforming with job requirements. All welds shall be smooth and without burrs. No nuts, bolts, or rivets shall be allowed in assembly of main locker groups. Optional Locked Compartment, Foot Locker, Vertical Partition, Half Shelves, and/or Drawer are not welded into assembly.
- I. Body: Assembled by welding body components together. Fabricate from unperforated steel sheet with thicknesses as follows:
 - 1. Locker body components shall be made of cold rolled steel specially formed for
 - 2. Locker body frame shall be tubular steel with backed enamel finish.
 - 3. Locker body side panels, shelf and floor shall be metal mesh.
 - 4. Locker body top shall be open.

5. Locker body front shall be open.

J. Finish: Baked enamel.

1. Color(s): As selected by Architect from manufacturer's full range.

2.3 FABRICATION

A. Fabricate metal lockers square, rigid, and without warp and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.

1. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.
2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.

B. All-Welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections; with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds flush.

C. Hooks: Manufacturer's standard ball-pointed type, aluminum or steel; zinc plated.

D. Coat Rods: Fabricated from 3/4-inch-diameter steel, nickel plated.

2.4 STEEL SHEET FINISHES

A. Factory finish steel surfaces and accessories except stainless-steel and chrome-plated surfaces.

B. Baked-Enamel Finish: Immediately after cleaning, pretreating, and phosphatizing, apply manufacturer's standard thermosetting baked-enamel finish. Comply with paint manufacturer's written instructions for application, baking, and minimum dry film thickness.

C. Powder-Coat Finish: Immediately after cleaning and pretreating, electrostatically apply manufacturer's standard, baked-polymer, thermosetting powder finish. Comply with resin manufacturer's written instructions for application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install level, plumb, and true; shim as required, using concealed shims.
 - 1. Anchor locker runs at ends and at intervals recommended by manufacturer.
 - 2. Anchor single rows of metal lockers to walls near top and bottom of lockers.
 - 3. Provide wood blocking in framed wall at locker locations suitable for positive connection of locker unit(s) to schedule wall type.
- B. All-Welded Metal Lockers: Connect groups together with standard fasteners, with no exposed fasteners on face frames.
- C. Equipment and Accessories: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
 - 1. Attach hooks with at least two fasteners.
 - 2. Attach recess trim to recessed metal lockers with concealed clips.
 - 3. Attach boxed end panels with concealed fasteners to conceal exposed ends of non-recessed metal lockers.

3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding.
- B. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.
- C. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 10 5113

SECTION 10 7500 - FLAGPOLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes ground-mounted aluminum flagpoles.

1.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Flagpole assemblies, including anchorages and supports, shall withstand the effects of gravity loads, and the following loads and stresses within limits and under conditions indicated according to the following design criteria:
 - 1. Seismic Loads: <Insert seismic criteria> according to SEI/ASCE 7.
 - 2. Wind Loads: Wind speed and exposure factor according to NAAMM FP 1001, "Guide Specifications for Design of Metal Flagpoles."
 - 3. Base flagpole design on polyester flags of maximum standard size suitable for use with flagpole.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Delegated-Design Submittal: For flagpole assemblies indicated to comply with performance requirements and design criteria, including analysis data and calculations signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Include loads, point reactions, and locations for attachment of flagpoles to building's structure.
- C. Operation and Maintenance Data: For flagpoles to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Colonial Flag – IWM40C82-AA or comparable product by one of the following:
 - 1. American Flagpole; a Kearney-National Inc. company.
 - 2. Atlantic Fiberglass Products, Inc.
 - 3. Concord Industries, Inc.
 - 4. Colonial Flag

5. Eder Flag Manufacturing Company, Inc.
6. Ewing Flagpoles.
7. Lingo Inc.; Acme Flagpole Company Division.
8. Millerbernd Manufacturing Company.
9. Morgan-Francis; Division of Original Tractor Cab Co., Inc.
10. PLP Composite Technologies, Inc.
11. Pole-Tech Company Inc.
12. U.S. Flag & Flagpole Supply, LP.
13. USS Manufacturing Inc.

2.2 FLAGPOLES

- A. Exposed Height: 1 at 50 feet
- B. Aluminum Flagpoles: Provide cone-tapered flagpoles fabricated from seamless extruded tubing complying with ASTM B 241/B 241M, Alloy 6063, with a minimum wall thickness of 0.156.
- C. Metal Foundation Tube: Manufacturer's standard corrugated-steel foundation tube, not less than 0.064-inch nominal wall thickness. Provide with 3/16-inch steel bottom plate and support plate; 3/4-inch diameter, steel ground spike; and steel centering wedges welded together. Galvanize steel after assembly. Provide loose hardwood wedges at top of foundation tube for plumbing pole. Provide flashing collar of same material and finish as flagpole.
- D. Cast-Metal Shoe Base: For anchor-bolt mounting; provide with anchor bolts.
- E. Finial Ball: Manufacturer's standard flush-seam ball, sized as indicated or, if not indicated, to match flagpole-butt diameter. Fabricate from 0.063-inch spun aluminum, finished to match flagpole.
 1. Diameter: 4 inches.
- F. Internal M-Winch System: Manually operated crank that wraps the internal cable around the winch.
- G. Lanyards: (2) Snap-hooks.
- H. Flash Collar: 12 inches by 6 inches, aluminum.
- I. Windspeed: 80 mph
- J. Flag Size:
 1. Flag No. 1- US Flag, 8 feet wide by 12 feet long, polyester.
 2. Flag No. 2- Utah Flag, 8 feet wide by 12 feet long, polyester.
 3. Flag No. 3- Murray City Flag, 8 feet wide by 12 feet long, polyester.

2.3 MISCELLANEOUS MATERIALS

- A. Non-shrink, Nonmetallic Grout: Factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C 1107.
- B. Sand: ASTM C 33, fine aggregate.
- C. Elastomeric Joint Sealant: Joint sealant complying with requirements in Division 07 Section "Joint Sealants."

2.4 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 FLAGPOLE INSTALLATION

- A. General: Install flagpoles where shown and according to Shop Drawings and manufacturer's written instructions.
- B. Ground Set: Place foundation tube, center, and brace to prevent displacement during concreting. Install flagpole, plumb, in foundation tube. Place tube seated on bottom plate between steel centering wedges and install hardwood wedges to secure flagpole in place. Place and compact sand in foundation tube and remove hardwood wedges. Seal top of foundation tube with a 2-inch layer of elastomeric joint sealant and cover with flashing collar.
- C. Baseplate: Cast anchor bolts in concrete foundation. Install baseplate on washers placed over leveling nuts on anchor bolts and adjust until flagpole is plumb. After flagpole is plumb, tighten retaining nuts and fill space under baseplate solidly with non-shrink, nonmetallic grout. Finish exposed grout surfaces smooth and slope 45 degrees away from edges of baseplate.
- D. Mounting Brackets and Bases: Anchor brackets and bases securely through to structural support with fasteners as indicated on Shop Drawings.

END OF SECTION 10 7500

SECTION 11 3100 - RESIDENTIAL APPLIANCES AND SPECIALTY LAUNDRY EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. PART 2 – PRODUCTS shall indicate Appliances and Special Laundry Equipment that are NOT IN CONTRACT and that are IN CONTRACT. Also indicated is instruction shall be General Contractors responsibilities for each Appliance and Special Laundry Equipment.
- B. Section Includes Residential Appliances:
 - 1. Cooking equipment including:
 - a. Ranges.
 - 1) Cook-Top Hood with ventilator.
 - 2) Cook-Top Appliance
 - 3) Gas range with double oven.
 - b. Microwave Ovens.
 - 2. Refrigerator/freezers.
 - 3. Cleaning appliances:
 - a. Dishwashers.
 - b. Clothes washers.
 - c. Clothes dryers.
 - 4. Food Waste Disposal.
 - 5. Dryer Ventilation.
- C. Section Includes Specialty Laundry Equipment:
 - 1. Gear dryer.
 - 2. Commercial washer-extractor.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, dimensions, furnished accessories, and finishes for each appliance.
- B. Product Data: for indicated products, indicating compliance with requirements for ENERGY STAR product labeling.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer and manufacturer.
- B. Product Certificates: For each type of appliance, from manufacturer.
- C. Field quality-control reports.
- D. Warranties: Sample of special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each residential appliance and laundry equipment to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer for installation and maintenance of units required for this Project.
- B. High-Altitude Conversion: Provide gas-operated appliances with manufacturer's conversion kit installed by a qualified service agency according to manufacturer's written instructions for Project location and type of fuel.
- C. Regulatory Requirements: Comply with the following:
 - 1. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.7 WARRANTY

- A. General:
 - 1. Manufacturer's standard form in which manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period.

PART 2. - PRODUCTS

2.1 MANUFACTURERS

- A. The list below of Appliances and Special Laundry Equipment was selected by owner as Basis-of-Design. Any change to the listed IN CONTRACT Appliances shall be submitted to the Architect for review and approval by Owner prior to General Contractor's purchase of IN CONTRACT Appliances and Special Laundry Equipment. The NOT IN CONTRACT Appliances and Special Laundry Equipment shall be purchased by the Owner and installed by the Owner on a later date. However, Power, Water and Drainage for each NOT IN CONTRACT and IN CONTRACT Appliances and Special Laundry Equipment shall be provided by the General Contractor.
- B. KITCHEN 109
1. Refrigerators: NOT IN CONTRACT. Owner shall provide and owner shall install this equipment on a later date. General Contractor shall provide power and water to applicable locations.
 2. Dishwasher: NOT IN CONTRACT. Owner shall provide and owner shall install this equipment on a later date. General Contractor shall provide power and water to applicable location.
 3. Cook Top Range: IN CONTRACT. General Contractor Shall provide and General Contractor shall install this equipment.
 - a. ZLINE, 1-614-777-5004, ZLINE 48inch Range-top Professional Stainless Steel Gas Range-top (RT48), (7) Burners with Porcelain cooktop and electronic spark ignition for all burners, Cast Iron Grill, Stainless Steel.
 4. Double Wall Oven: IN CONTRACT. General Contractor shall provide and General Contractor shall install this equipment.
 - a. Viking, 1-888-845-4641, 5 Series Built-in Select Electric Ovens, model VDOE 130, Stainless Steel finish.
 5. Convection Microwave Oven: IN CONTRACT. General Contractor shall provide and General Contractor shall install this equipment.
 - a. Viking, 1-888-845-4641, 5 Series – VMOC506 with VMTK307 30inch wide trim kit, Stainless Steel finish.
 6. Range Hood: IN CONTRACT. General Contractor shall provide and General Contractor shall install this equipment.
 - a. ZLINE, 1-614-777-5004, Wall Mounted, Stainless Steel KB Exhaust Hood, 48inch wide x 19.7inches deep x 10.5inches high, lighting, 4- speeds, Noise Level 20/29/34/41 at CFM 120/240/320/400 respectively.
- C. LAUNDRY ROOM103
1. Ice Machine and Ice Storage: NOT IN CONTRACT. Owner shall provide and owner shall install this equipment on a later date. General Contractor shall provide power, water and drainage to applicable location.
 2. Clothes Washer: NOT IN CONTRACT. Owner shall provide and owner shall install this equipment on a later date. General Contractor shall provide power, water and drainage to applicable location.
 3. Clothes Dryer: NOT IN CONTRACT. Owner shall provide and owner shall install this equipment on a later date. General Contractor shall provide power to applicable location.
- D. UTILITY ROOM 112
1. Clothes Washer: NOT IN CONTRACT. Owner shall provide and owner shall install this equipment on a later date. General Contractor shall provide power, water and drainage to applicable location.

2. Clothes Dryer: NOT IN CONTRACT. Owner shall provide and owner shall install this equipment on a later date. General Contractor shall provide power to applicable location.
- E. OUTDOOR EQUIPMENT
1. BBQ Grill: IN CONTRACT. General Contractor shall provide and General Contractor shall install this equipment.
 - a. Basis-of Design is Weber Summit S-660 Built-In Natural Gas Grill with Rotisserie and Sear Burner – Model #7460001. Substitutions shall be reviewed and approved by the Architect.
 - b. Stainless Steel exterior Primary Color.
 - c. Six Main Burners.
 - d. 60,000 Grilling Surface BTU's.
 - e. 10,600 Rotisserie Burner BTU's.
 - f. Stainless Steel Cooking Grate Material.
 - g. Rotisserie kit included
 - h. Analog Thermometer built into Grill Hood.
 - i. Storage area beneath Grill with Stainless Steel doors and Stainless Steel perimeter enclosure.

PART 2 - EXECUTION

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.
- C. Examine walls, ceilings, and roofs for suitable conditions where microwave ovens with vented exhaust fans will be installed.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. General: Comply with manufacturer's written instructions.
- B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.

- C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.
- D. Range Anti-Tip Device: Install at each range according to manufacturer's written instructions.
- E. Utilities: See Divisions 22 and 26 for plumbing and electrical requirements.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
 - 2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After installation, start units to confirm proper operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.
- C. An appliance will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain residential appliances.

END OF SECTION 11 3100

SECTION 12 3216 - MANUFACTURED PLASTIC-LAMINATED-FACED CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes custom milled plastic laminate cabinets and casework, shelving and brackets, shown on the drawings and specified herein.
- B. Related Sections:
 - 1. Division 09 section "non-structural metal framing" for reinforcements in metal-framed partitions for blocking required for anchoring cabinets.
 - 2. Plumbing and electrical connections- see mechanical & electrical divisions.
 - 3. Division 09 Section "Resilient Base and Accessories" for top set rubber or vinyl base.
 - 4. Division 11 Section "Residential Appliances" for Kitchen/Kitchenette appliances.
 - 5. Division 12 Section "Simulated Stone Countertops" for solid-surfacing-material countertops.
 - 6. Division 22 Section "Plumbing Fixtures for integral sinks, non-integral sinks and plumbing fittings.

1.2 SUBMITTALS

- A. Shop Drawings; Submit shop layout plans, elevations, and in detail construction of all parts of the work, including material thickness, methods of joinery, anchorage, and finish.

1.3 COORDINATION

- A. Coordinate with other trades whose work is affected by the work of this section to assure timely completion of the work.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. This specification is based on the custom-built products of Huetter Mill and Fixture Company and such products shall meet or exceed the minimum requirements of the following specifications.
- B. Approved Mills:
 - 1. Excel Cabinets, Salt Lake City, UT
 - 2. Granite Mill, Salt Lake City, UT
 - 3. Huetter Mill and Cabinet Company, Salt Lake City, UT

2.2 GENERAL CONSTRUCTION (PLASTIC LAMINATE)

- A. All cabinets shall be complete and finished at the factory. All exterior surfaces shall be decorative high-density cross-linked polymer alloy overlay surface meeting the performance requirements of NEMA Standard LD3-1975, Grade GP28 and PF30. All interior surfaces shall be finished with a high density overlay in color selected by Architect.
- B. All edge banding to be one type, impact and mar resistant, set with adhesive.
- C. All cabinets shall be manufactured with hinge doors, drawers, and face panels factory attached in an overlay design. Doors shall be capable of opening a full 170 degrees.
- D. Shelves shall be adjustable on 1" centers and shall be furnished with steel clips capable of securing the shelf in a fixed position.

2.3 CASEWORK MATERIAL

- A. High pressure plastic laminate for horizontal surfaces shall be equal to or exceed requirements for NEMA Publication LD3-1975 GP50 – Abrasion Class I, 0.05" thick, velvet finish with a gloss reading of 8 plus or minus 3. Vertical surfaces shall be equal to or exceed requirements of NEMA Publication LD3-1975, Type PG28 and PF30, 0.03" thick, velvet finish with gloss reading of 8 plus or minus 3.
 - 1. Color shall be selected from standard colors of Formica, Nevamar, Pionite or Wilson Art.
 - 2. Chemical Resistant Tops: Wilson Art chem-surf or approved equal.
- B. High-pressure plastic laminate shall be bonded to core with a liquid polyvinyl acetate or a urea resin adhesive at temperatures above 65 degrees F. at a pressure no less than 15 pounds per square inch. Laminate and core are not to exceed 10% moisture content and are to be laminated and cured in a controlled environment between 40% and 60% relative humidity.
- C. Composition Board: High grade particle board with an average of 45 pounds per cubic density and a minimum of 85% moisture content.
- D. Hardboard: Prefinished beige color, smooth 2 sides, oil impregnated wood fiber, uniform and free from defects.
- E. Edgings: 3mm PVC Multipolymer banding, color selected by architect, guaranteed not to craze or crack where wrapped around corners. (butyrate is not acceptable)

2.4 HARDWARE

- A. Finish Hardware
 - 1. Hinges: European hinge, Bloom, 71T6580, 170 deg. or equal.
 - 2. Pulls: Hardware Concepts, HC2867Bk, satin black, semi-recessed ABS plastic pull.
 - 3. Catches: Amerock No. 9823-2G, Friction roller catch.
 - 4. Sliding door track: Epco No. 821 bottom track, No. 2234 upper track.

5. Drawer slides: Accuride #3832, 100 lb load rating, ball bearing slide.
 6. File drawer slides: Accuride #4034, 150 lb load rating, ball bearing slide.
 7. File drawer follower rods: Knappe & Vogt No. 476.
 8. Adjustable Shelf Clips: Knappe & Vogt No. 345 nickel plated clip.
 9. Casters: Colson No. 2.03689.54 heavy duty 4inch overall hard wheel, No. 2.03689.54 B3 with brake.
 10. Locks: National No. C-8053-14A disc tumber cam lock. Coordinate with Owner for cabinetry doors and drawers to have locks.
 11. Screws: Reed and prince square drive screws. Standard wood screws and sheet metal screws are not acceptable.
 12. Brackets: Fast-cap, Speed brace, White epoxy, Heavy duty support.
- B. Adjustable Shelving: Knappe & Vogt No. 82/182, White epoxy heavy duty shelving supports.

2.5 COMPONENT CONSTRUCTION

- A. Doors shall be 1/32inch high-pressure plastic laminate. Core shall be 3/4inch, 45 lb. composition board. 1/32inch cabinet liner on the inside face. Edges shall be finished with white plastic edging.
- B. Drawers: Fronts shall be 1/32inch high-pressure plastic laminate, edge with white plastic. Sides shall be 5/8inch Baltic birch with multiple dovetail joints. Finish with 3 coats of lacquer. Core shall be 3/4inch, 45 lb. composition board faced with cabinet liner inside. Bottom shall be 1/4inch composition board faced with plastic overlay let into front, sides and back. Sub-front shall be 3/4inch white plastic overlay attached with No. 12 screws. Drawers installed with all nylon roller ball bear metal sides rated for 100 lb. load and extending all but 4inch of the drawers. Full suspension file drawers shall be mounted with slides rated for 100 lb. load. All drawers shall be mounted with positive tops to provide permanent alignment and quite operation.
- C. Partitions: White plastic on 3/4inch, 45 lb. composition board.
- D. Adjustable shelves: White plastic on 2 sides, 1inch thick for all shelves. Edge in white 3 mm PVC edging.
- E. Bottoms: White plastic overlay on 3/4inch, 45 lb. composition board.
- F. All cabinets backs shall have 1/4inch composition board finished with plastic laminate matching end panels.

PART 3 - EXECUTION

3.1 PREFINISHED FIXED CASEWORK

- A. All parts shall be accurately machined and fit for square and true cases. Case joints shall be dado, glued, and stapled at 4inches O.C. Tall and upper cases shall also have No. 10 x 1-3/4inch screws at 12inches O.C. at top and bottom.

- B. Backs are to be rabbeted into cabinet ends, glued, and stapled. Backs on wall hung cases shall also be screwed to top and bottom members so units can be installed without angles or rails.
- C. Tops of tall and upper cases shall be finished to match end panels. Sub-tops of base cabinets shall be 3/4inch, 45pound composition board.
- D. All exposed edges on upper cabinets shall be edged with multipolymer edge banding.
- E. Stretchers, rails, and toe kick base shall be 3/4inch plywood dado, glued, and stapled into ends.
- F. Wall cabinets shall be finished on all sides, with recessed bottoms with filler piece below shelf faced with standard white plastic laminate formed as an integral part of the cabinet. Applied bottom soffits shall not be acceptable.

3.2 TESTING AND PERFORMANCE

- A. A wall hung cabinet should be capable of being loaded as per industry standards without any signs of stress or failure from cabinet pulling away from the wall.

3.3 EQUIPMENT BY OTHERS

- A. Provide sink and fitting cut outs. Installation of sinks, fittings, plumbing rough-in and final connection, and electrical rough and final connection shall be by Divisions 22 (plumbing) and 26 (Electrical).

3.4 INSTALLATION OF SHELVING

- A. Provide seismic bracing when required in accordance with the International Building Code, latest edition.

3.5 CLEANUP

- A. Refer to Section 01 7300.
- B. At completion of this work, remove all debris from the site. Thoroughly clean all cabinets inside and out. Vacuum shavings, dust and dirt from inside cases, drawers, and from cabinet tops. Clean marks, mars, and stains ready for use by the Owner.
- C. Make all necessary final adjustments of doors, drawers, and other moveable items. Protect installed items until accepted by the Owner. Replace damaged items at no additional cost to the Owner.

END OF SECTION 12 3216

SECTION 123640 - STONE COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes stone countertops.

1.2 SUBMITTALS

- A. Product Data: For each variety of stone.
- B. Shop Drawings: Include plans, sections, details, and attachments to other work.
- C. Samples: For each stone type indicated.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Source Limitations for Stone: Obtain each variety of stone from a single quarry with resources to provide materials of consistent quality in appearance and physical properties.
 - 1. Make stone slabs available for Architect to examine for appearance characteristics. Architect will select aesthetically acceptable slabs.

1.4 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions of construction to receive stone countertops by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 GRANITE

- A. Manufacturers and Suppliers:
 - 1. Intermountain Stone & Marble: (801) 266-4241.
 - 2. Bedrosians Tile & Stone: (801) 466-6641.
 - 3. Creative Granite & Design: (801) 889-0204.
 - 4. The Stone Collection: (801) 875 4460
- B. Granite: Comply with ASTM C 615.
- C. Varieties and Sources: Subject to compliance with requirements, provide the following:

1. Product: 2-cm; As selected from Manufacturers and Suppliers full range of color.
- D. Finish: Polished.
- E. Edge Detail: 4 cm full bull-nose; polished.

2.2 ADHESIVES, GROUT, SEALANTS, AND STONE ACCESSORIES

- A. Water-Cleanable Epoxy Adhesive: ANSI A118.3.
1. Available Manufacturers: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bonsal, W. R. Company.
 - b. Bonstone Materials Corporation.
 - c. C-Cure.
 - d. Custom Building Products.
 - e. Laticrete International, Inc.
 - f. MAPEI Corp.
 - g. Summitville Tiles, Inc.
- B. Water-Cleanable Epoxy Grout: ANSI A118.3, chemical-resistant, water-cleanable, tile-setting and -grouting epoxy.
1. Available Manufacturers: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Boiardi Products Corporation.
 - b. W. R. Bonsal Company.
 - c. Bostik Findley Inc.
 - d. C-Cure.
 - e. Custom Building Products.
 - f. Laticrete International, Inc.
 - g. MAPEI Corp.
 - h. Summitville Tiles, Inc.
 - i. TEC Incorporated; H. B. Fuller Company.
- C. Sealant for Countertops: Manufacturer's standard sealant of characteristics indicated below that comply with applicable requirements in Division 07 Section "Joint Sealants" and will not stain the stone it is applied to.
1. Single-component, neutral-curing silicone sealant.
 2. Color: Clear.

- D. Stone Sealer: Colorless, stain-resistant sealer that does not affect color or physical properties of stone surfaces, as recommended by stone producer for application indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bostik Findley Inc.
 - b. Custom Building Products.
 - c. Hillyard, Inc.
 - d. HMK Stone Care System.
 - e. Miracle Sealants Company.
 - f. Stone Care International Inc.
 - g. Summitville Tiles, Inc.

2.3 STONE FABRICATION

- A. Select stone for intended use to prevent fabricated units from containing cracks, seams, and starts that could impair structural integrity or function.
- B. Fabricate stone countertops in sizes and shapes required to comply with requirements indicated, including details on Drawings and Shop Drawings.
 - 1. Dress joints straight and at right angle to face, unless otherwise indicated.
 - 2. Fabricate molded edges with machines having abrasive shaping wheels made to reverse contour of edge profile to produce uniform shape throughout entire length of edge.
 - 3. Finish exposed faces of stone to comply with requirements indicated. Provide matching finish on exposed edges of countertops, splashes, and cutouts.
- C. Nominal Thickness: Provide thickness indicated, but not less than 3/4 inch (2cm).
- D. Splashes: Provide 3/4-inch (2cm) thick backsplashes and end splashes, 4" high, unless otherwise indicated.
- E. Joints: Fabricate countertops without joints when possible. Provide approval of joint locations with owner. Provide consistent thickness of stone where joint may occur.
- F. Cutouts and Holes:
 - 1. Undercounter Fixtures: Make cutouts for undercounter fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
 - 2. Counter-Mounted Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
 - 3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

PART 3 - EXECUTION

3.1 INSTALLATION OF COUNTERTOPS

- A. General: Install countertops over plywood sub-tops with full spread of water-cleanable epoxy adhesive.
- B. General: Install countertops by adhering to supports with water-cleanable epoxy adhesive.
- C. Set stone to comply with requirements indicated on Drawings and Shop Drawings. Shim and adjust stone to locations indicated, with uniform joints of widths indicated and with edges and faces aligned according to established relationships.
- D. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Use power saws with diamond blades to cut stone. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
- E. Install backsplash and end splash by adhering to wall with water-cleanable epoxy adhesive. Leave 1/16-inch gap between countertop and splash for filling with sealant. Use temporary shims to ensure uniform spacing.
- F. Grout joints to comply with ANSI A108.10. Remove temporary shims before grouting. Tool grout uniformly and smoothly with plastic tool.
- G. Apply sealant to joints and gaps specified for filling with sealant; comply with Division 07 Section "Joint Sealants." Remove temporary shims before applying sealant.

3.2 ADJUSTING AND CLEANING

- A. In-Progress Cleaning: Clean countertops as work progresses. Remove adhesive, grout, mortar, and sealant smears immediately.
- B. Clean stone countertops not less than six days after completion of sealant installation using clean water and soft rags. Do not use wire brushes, acid-type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials or methods that could damage stone.
- C. Sealer Application: Apply stone sealer to comply with stone producer's and sealer manufacturer's written instructions.

END OF SECTION 123640

DIVISION 21

TABLE OF CONTENTS

DIVISION 21 – FIRE PROTECTION

211313 WET PIPE SPRINKLER SYSTEMS

211316 DRY PIPE SPRINKLER SYSTEMS

END OF TABLE OF CONTENTS

SECTION 211313

WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipes, fittings, and specialties.
 - 2. Specialty valves.
 - 3. Sprinklers.
 - 4. Alarm devices.
 - 5. Pressure gages.
 - 6. Exposed-type fire-department connections.

1.3 DEFINITIONS

- A. 175 psig Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.
- B. AHJ: Authority Having Jurisdiction.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 2. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each fire-department connection.
- B. Shop Drawings: For wet-pipe sprinkler systems.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include diagrams for power, signal, and control wiring.
- C. Delegated-Design Submittal: For wet-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Domestic water piping.
 - 2. Compressed air piping.
 - 3. HVAC Ductwork.
 - 4. Equipment Flues.
 - 5. Drain, Waste, and Vent Piping.
 - 6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Acoustical Treatments
- B. Qualification Data: For qualified Installer.
- C. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- D. Welding certificates.
- E. Fire-hydrant flow test report.
- F. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
- G. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
- B. Welding Qualifications: Qualify procedures and operators according to 2010 ASME Boiler and Pressure Vessel Code.

1.9 FIELD CONDITIONS

- A. Interruption of Existing Work Functions: Do not interrupt work functions in the existing building unless notification and acceptance by Owner has been received:
 1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of work functions.
 2. Do not proceed with interruption without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Project scope:
 1. New construction: provide a wet-pipe fire sprinkler system in all areas of the building. The new system shall be supplied from the new riser in the Fire Riser Room. The final installation shall be acceptable to the owner and AHJ.
 2. Provide concealed sprinklers in public and group areas. Architect may request additional locations be provided with concealed sprinklers.
 3. Sprinkler heads should be centered on one half of all 2x4 acoustical tiles and centered on all 2x2 acoustical tiles in all areas.
 4. Coordination with other trades is important. Sprinkler locations, types, and colors not complying with above and not approved by the architect in writing and installed shall be removed and surfaces repaired at no cost by the fire sprinkler contractor.
- B. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
 1. NFPA 13, 2010 Edition unless otherwise directed by AHJ.
 2. Local codes or ordinances.
- C. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
- D. Delegated Design: Engage a qualified professional engineer or NICET Level III technician to design wet-pipe sprinkler systems.
 1. Perform a water flow test near the site and publish results to architect and EOR for review. Information that should be included in the published results includes, but is not limited to, the following:
 - a. Date.

- b. Time.
 - c. Performed by, name and firm.
 - d. Water utility and name of contact/witness.
 - e. Location of Residual Fire Hydrant R.
 - f. Location of Flow Fire Hydrant F.
 - g. Static Pressure at Residual Fire Hydrant R psig.
 - h. Measured Flow at Flow Fire Hydrant F gpm.
 - i. Residual Pressure at Residual Fire Hydrant R psig.
2. Sprinkler system design shall be approved by authorities having jurisdiction.
- a. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 - b. Sprinkler Occupancy Hazard Classifications:
 - 1) Building Service Areas: Ordinary Hazard, Group 1.
 - 2) Electrical Equipment Rooms: Ordinary Hazard, Group 1.
 - 3) General Storage Areas: Ordinary Hazard, Group 1.
 - 4) Laundries: Ordinary Hazard, Group 1.
 - 5) Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
 - 6) Office and Public Areas: Light Hazard.
 - 7) Other areas not meeting the space classifications above shall be brought to the attention of the architect for review and classification.
3. Minimum Density for Automatic-Sprinkler Piping Design:
- a. 0.05 gpm over 400-sq. ft. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
 - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
 - c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
 - d. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2500-sq. ft. area.
 - e. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over 2500-sq. ft. area.
 - f. Special Occupancy Hazard: As determined by authorities having jurisdiction.
4. Maximum Protection Area per Sprinkler: According to UL listing.
- E. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

2.2 STEEL PIPE AND FITTINGS

- A. Schedule 40, Black-Steel Pipe: ASTM A 135/A 135M; ASTM A 795/A 795M, Type E; Pipe ends may be factory or field formed to match joining method.
- B. Galvanized- and Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- C. Galvanized- and Uncoated-Steel Couplings: ASTM A 865/A 865M, threaded.
- D. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- E. Malleable- or Ductile-Iron Unions: UL 860.
- F. Cast-Iron Flanges: ASME 16.1, Class 125.

- G. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
 - 1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick ASME B16.21, nonmetallic and asbestos free or EPDM rubber gasket.
 - a. Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
 - b. Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.
 - 2. Metal, Pipe-Flange Bolts and Nuts: Carbon steel unless otherwise indicated.
- H. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
 - 1. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- I. Grooved-Joint, Steel-Pipe Appurtenances:
 - 1. Pressure Rating: 175-psig minimum.
 - 2. Uncoated Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting, with dimensions matching steel pipe.
 - 3. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 SPECIALTY VALVES

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- B. Pressure Rating:
 - 1. Standard-Pressure Piping Specialty Valves: 175-psig minimum.
- C. Body Material: Cast or ductile iron.
- D. Size: Same as connected piping.
- E. End Connections: Flanged or grooved.
- F. Automatic (Ball Drip) Drain Valves:
 - 1. Standard: UL 1726.
 - 2. Pressure Rating: 175-psig minimum.
 - 3. Type: Automatic draining, ball check.
 - 4. Size: NPS 3/4.
 - 5. End Connections: Threaded.

2.4 SPRINKLER PIPING SPECIALTIES

- A. Branch Outlet Fittings:
 - 1. Standard: UL 213.
 - 2. Pressure Rating: 175-psig minimum
 - 3. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
 - 4. Type: Mechanical-tee and -cross fittings.

5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
 6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
 7. Branch Outlets: Grooved, plain-end pipe, or threaded.
- B. Flow Detection and Test Assemblies:
1. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
 2. Pressure Rating: 175-psig minimum
 3. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
 4. Size: Same as connected piping.
 5. Inlet and Outlet: Threaded or grooved.
- C. Sprinkler Inspector's Test Fittings:
1. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
 2. Pressure Rating: 175-psig minimum
 3. Body Material: Cast- or ductile-iron housing with sight glass.
 4. Size: Same as connected piping.
 5. Inlet and Outlet: Threaded.
- D. Flexible Sprinkler Hose Fittings:
1. Standard: UL 1474.
 2. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
 3. Pressure Rating: 175-psig minimum 300 psig.
 4. Size: Same as connected piping, for sprinkler.

2.5 SPRINKLERS

- A. Acceptable Manufacturers:
1. [Reliable Automatic Sprinkler Co.](#)
 2. [Tyco Fire & Building Products LP.](#)
 3. [Victaulic Company.](#)
 4. [Viking Corporation.](#)
- B. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- C. Pressure Rating for Residential Sprinklers: 175-psig maximum.
- D. Pressure Rating for Automatic Sprinklers: 175-psig minimum.
- E. Pressure Rating for High-Pressure Automatic Sprinklers: 250-psig minimum
- F. Automatic Sprinklers with Heat-Responsive Element:
1. Nonresidential Applications: UL 199.
 2. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
- G. Sprinkler Finishes: as directed by architect.

- H. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
 - 1. Ceiling Mounting: one piece, with minimum 0.51-inch vertical adjustment.
 - 2. Sidewall Mounting: one piece, with minimum 0.5-inch vertical adjustment.
- I. Sprinkler Guards:
 - 1. Standard: UL 199.
 - 2. Type: Wire cage with fastening device for attaching to sprinkler.

2.6 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Operated Alarm Bell:
 - 1. Standard: UL 464.
 - 2. Type: Vibrating, metal alarm bell.
 - 3. Size: 6-inch minimum diameter.
 - 4. Finish: Red-enamel factory finish, suitable for outdoor use.
 - 5. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application
- C. Sprinkler Alarm Horn Strobe and Sign Combination
 - 1. The device shall consist of a weatherproof 24 V strobe horn, weatherproof backbox and red non corrosive sign with white lettering identifying it as a sprinkler alarm with instructions to contact the fire department or 911. The strobe horn shall be cULus Listed. Sprinkler Alarm Strobe Horn shall be model SASH12/24.
- D. Water-Flow Indicators:
 - 1. Standard: UL 346.
 - 2. Water-Flow Detector: Electrically supervised.
 - 3. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
 - 4. Type: Paddle operated.
 - 5. Pressure Rating: 250 psig.
 - 6. Design Installation: Horizontal or vertical.
- E. Valve Supervisory Switches:
 - 1. Standard: UL 346.
 - 2. Type: Electrically supervised.
 - 3. Components: Single-pole, double-throw switch with normally closed contacts.
 - 4. Design: Signals that controlled valve is in other than fully open position.
 - 5. 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

2.7 NPS 1/2NPS 1/2PRESSURE GAGES

- A. Standard: UL 393.

- B. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- C. Pressure Gage Range: 0- to 250-psig minimum.
- D. Label: Include "WATER" label on dial face.

2.8 EXPOSED-TYPE FIRE-DEPARTMENT CONNECTION

- A. Standard: UL 405.
- B. Type: Exposed, projecting, for wall mounting.
- C. Pressure Rating: 175 psig minimum.
- D. Body Material: Corrosion-resistant metal.
- E. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
- F. Caps: Brass, lugged type, with gasket and chain.
- G. Escutcheon Plate: Round, brass, wall type.
- H. Outlet: Back, with pipe threads.
- I. Number of Inlets: Two .
- J. Escutcheon Plate Marking: Similar to "AUTO SPKR ."
- K. Finish: Rough brass or bronze unless otherwise directed by owner or AHJ.
- L. Outlet Size: NPS 4.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING

- A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Section 211100 "Facility Fire-Suppression Water-Service Piping" for exterior piping.

- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.

3.3 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
 - 2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.
- C. Install seismic restraints on piping. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
- K. Install alarm devices in piping systems.
- L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13. In seismic-rated areas, refer to Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."
- M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they are not subject to freezing.
- N. Fill sprinkler system piping with water.

- O. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- P. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.4 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
 - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- J. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- K. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

- L. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.5 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
 - 1. Install valves in vertical position for proper direction of flow, in main supply to system.
 - 2. Install alarm valves with bypass check valve and retarding chamber drain-line connection.
 - 3. Install deluge valves in vertical position, in proper direction of flow, and in main supply to deluge system. Install trim sets for drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

3.6 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.
- B. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.7 FIRE DEPARTMENT CONNECTION EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of fire-department connections.
- B. Examine roughing-in for fire-suppression standpipe system to verify actual locations of piping connections before fire-department connection installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.8 FIRE DEPARTMENT CONNECTION INSTALLATION

- A. Install wall-type fire-department connections.
- B. Install automatic (ball-drip) drain valve at each check valve for fire-department connection.

3.9 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.10 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 4. Energize circuits to electrical equipment and devices.
 - 5. Coordinate with fire-alarm tests. Operate as required.
 - 6. Verify that equipment hose threads are same as local fire department equipment.
- B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.11 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.12 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain the system.

END OF SECTION 211313

SECTION 211316

DRY-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Specialty valves.
3. Sprinkler specialty pipe fittings.
4. Sprinklers.
5. Alarm devices.
6. Manual control stations.
7. Control panels.
8. Pressure gages.

B. Related Requirements:

1. Section 211119 "Fire Department Connections" for exposed-, flush-, and yard-type fire department connections.
2. Section 210523 "Fire Protection Piping" for ball, butterfly, check, gate, post-indicator, and trim and drain valves.

1.3 DEFINITIONS

- A. Standard-Pressure Sprinkler Piping: Dry-pipe sprinkler system piping designed to operate at working pressure of 175-psig (1200-kPa) maximum.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For dry-pipe sprinkler systems.

1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.

- C. Delegated-Design Submittal: For dry-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Domestic water piping.
 - 2. Compressed air piping.
 - 3. HVAC Ductwork.
 - 4. Equipment Flues.
 - 5. Drain, Waste, and Vent Piping.
 - 6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Acoustical Treatments
- B. Design Data:
 - 1. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- C. Fire-hydrant flow test report.
- D. Welding certificates.
- E. Field Test Reports:
 - 1. Fire-hydrant flow test report.
 - 2. Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
- F. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For dry-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of

sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

1.9 FIELD CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:

1. Notify Construction Manager no fewer than three days in advance of proposed interruption of sprinkler service.
2. Do not proceed with interruption of sprinkler service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Project scope:

1. New construction: provide a dry-pipe fire sprinkler system in covered exterior areas. The new system shall be supplied from the new riser in the Fire Riser Room. The final installation shall be acceptable to the owner and AHJ.
2. Exposed sprinkler piping to be painted to match adjacent surfaces. Provide protective guard on all sprinkler heads located outdoors.
3. Coordination with other trades is important. Sprinkler locations, types, and colors not complying with above and not approved by the architect in writing and installed shall be removed and surfaces repaired at no cost by the fire sprinkler contractor.

B. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, 2010 Edition unless otherwise directed by AHJ.
2. Local codes or ordinances.

C. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

- D. Delegated Design: Engage a qualified professional engineer or NICET Level III technician to design wet-pipe sprinkler systems.
1. Perform a water flow test near the site and publish results to architect and EOR for review. Information that should be included in the published results includes, but is not limited to, the following:
 - a. Date.
 - b. Time.
 - c. Performed by, name and firm.
 - d. Water utility and name of contact/witness.
 - e. Location of Residual Fire Hydrant R.
 - f. Location of Flow Fire Hydrant F.
 - g. Static Pressure at Residual Fire Hydrant R **psig**.
 - h. Measured Flow at Flow Fire Hydrant F **gpm**.
 - i. Residual Pressure at Residual Fire Hydrant R **psig**.

2.2 SYSTEM DESCRIPTIONS

- A. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from opened sprinklers.
- B. Combined Dry-Pipe and Preaction Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Fire-detection system, located in same area as sprinklers, actuates tripping devices that open dry-pipe valve without loss of air pressure and actuates fire alarm. Water discharges from opened sprinklers.
- C. Single-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of fire-detection system, located in same area as sprinklers, opens deluge valve, permitting water to flow into sprinkler piping and to discharge from opened sprinklers.
- D. Double-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of a fire-detection system, located in same area as sprinklers, opens deluge valve, permitting water to flow into sprinkler piping. A closed solenoid valve in the sprinkler piping is opened by another fire-detection device; water will then discharge from opened sprinklers.

2.3 PERFORMANCE REQUIREMENTS

- A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
 1. NFPA 13.
 2. NFPA 13R.
- B. Standard-Pressure Piping System Component: Listed for **175-psig (1200-kPa)** minimum working pressure.

- A. Delegated Design: Engage a qualified professional engineer or NICET Level III technician to design wet-pipe sprinkler systems.
1. Perform a water flow test near the site and publish results to architect and EOR for review. Information that should be included in the published results includes, but is not limited to, the following:
 - a. Date.
 - b. Time.
 - c. Performed by, name and firm.
 - d. Water utility and name of contact/witness.
 - e. Location of Residual Fire Hydrant R.
 - f. Location of Flow Fire Hydrant F.
 - g. Static Pressure at Residual Fire Hydrant R **psig**.
 - h. Measured Flow at Flow Fire Hydrant F **gpm**.
 - i. Residual Pressure at Residual Fire Hydrant R **psig**.
 2. Sprinkler system design shall be approved by authorities having jurisdiction.
 - a. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 - b. Sprinkler Occupancy Hazard Classifications:
 - 1) Building Service Areas: Ordinary Hazard, Group 1.
 - 2) Electrical Equipment Rooms: Ordinary Hazard, Group 1.
 - 3) General Storage Areas: Ordinary Hazard, Group 1.
 - 4) Laundries: Ordinary Hazard, Group 1.
 - 5) Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
 - 6) Office and Public Areas: Light Hazard.
 - 7) Other areas not meeting the space classifications above shall be brought to the attention of the architect for review and classification.
 3. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. **0.05 gpm over 400-sq. ft.** Light-Hazard Occupancy: **0.10 gpm over 1500-sq. ft.** area.
 - b. Ordinary-Hazard, Group 1 Occupancy: **0.15 gpm over 1500-sq. ft.** area.
 - c. Ordinary-Hazard, Group 2 Occupancy: **0.20 gpm over 1500-sq. ft.** area.
 - d. Extra-Hazard, Group 1 Occupancy: **0.30 gpm over 2500-sq. ft.** area.
 - e. Extra-Hazard, Group 2 Occupancy: **0.40 gpm over 2500-sq. ft.** area.
 - f. Special Occupancy Hazard: As determined by authorities having jurisdiction.
 4. Maximum Protection Area per Sprinkler: According to UL listing.
- B. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

2.4 STEEL PIPE AND FITTINGS

- A. Schedule 40, Black-Steel Pipe: ASTM A 135/A 135M; ASTM A 795/A 795M, Type E; Pipe ends may be factory or field formed to match joining method.
- B. Galvanized- and Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

- C. Galvanized- and Uncoated-Steel Couplings: ASTM A 865/A 865M, threaded.
- D. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- E. Malleable- or Ductile-Iron Unions: UL 860.
- F. Cast-Iron Flanges: ASME 16.1, Class 125.
- G. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
 - 1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick ASME B16.21, nonmetallic and asbestos free or EPDM rubber gasket.
 - a. Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
 - b. Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.
 - 2. Metal, Pipe-Flange Bolts and Nuts: Carbon steel unless otherwise indicated.
- H. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
 - 1. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- I. Grooved-Joint, Steel-Pipe Appurtenances:
 - 1. Pressure Rating: 175-psig minimum.
 - 2. Uncoated Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting, with dimensions matching steel pipe.
 - 3. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.5 SPECIALTY VALVES

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- B. Pressure Rating:
 - 1. Standard-Pressure Piping Specialty Valves: 175-psig minimum.
- C. Body Material: Cast or ductile iron.
- D. Size: Same as connected piping.
- E. End Connections: Flanged or grooved.
- F. Automatic (Ball Drip) Drain Valves:
 - 1. Standard: UL 1726.
 - 2. Pressure Rating: 175-psig minimum.
 - 3. Type: Automatic draining, ball check.
 - 4. Size: NPS 3/4.
 - 5. End Connections: Threaded.

2.6 SPRINKLER PIPING SPECIALTIES

- A. Branch Outlet Fittings:
 - 1. Standard: UL 213.
 - 2. Pressure Rating: 175-psig minimum
 - 3. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
 - 4. Type: Mechanical-tee and -cross fittings.
 - 5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
 - 6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
 - 7. Branch Outlets: Grooved, plain-end pipe, or threaded.
- B. Flow Detection and Test Assemblies:
 - 1. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
 - 2. Pressure Rating: 175-psig minimum
 - 3. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
 - 4. Size: Same as connected piping.
 - 5. Inlet and Outlet: Threaded or grooved.
- C. Sprinkler Inspector's Test Fittings:
 - 1. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
 - 2. Pressure Rating: 175-psig minimum
 - 3. Body Material: Cast- or ductile-iron housing with sight glass.
 - 4. Size: Same as connected piping.
 - 5. Inlet and Outlet: Threaded.
- D. Flexible Sprinkler Hose Fittings:
 - 1. Standard: UL 1474.
 - 2. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
 - 3. Pressure Rating: 175-psig minimum 300 psig.
 - 4. Size: Same as connected piping, for sprinkler.

2.7 SPRINKLERS

- A. Acceptable Manufacturers:
 - 1. Reliable Automatic Sprinkler Co.
 - 2. Tyco Fire & Building Products LP.
 - 3. Victaulic Company.
 - 4. Viking Corporation.
- B. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- C. Pressure Rating for Residential Sprinklers: 175-psig maximum.
- D. Pressure Rating for Automatic Sprinklers: 175-psig minimum.
- E. Pressure Rating for High-Pressure Automatic Sprinklers: 250-psig minimum
- F. Automatic Sprinklers with Heat-Responsive Element:
 - 1. Nonresidential Applications: UL 199.

2. Characteristics: Nominal **1/2-inch** orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

G. Sprinkler Finishes: as directed by architect.

H. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: one piece, with minimum **0.51-inch** vertical adjustment.
2. Sidewall Mounting: one piece, with minimum **0.5-inch** vertical adjustment.

I. Sprinkler Guards:

1. Standard: UL 199.
2. Type: Wire cage with fastening device for attaching to sprinkler.

2.8 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Operated Alarm Bell:

1. Standard: UL 464.
2. Type: Vibrating, metal alarm bell.
3. Size: **6-inch** minimum diameter.
4. Finish: Red-enamel factory finish, suitable for outdoor use.
5. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application

C. Sprinkler Alarm Horn Strobe and Sign Combination

1. The device shall consist of a weatherproof 24 V strobe horn, weatherproof backbox and red non corrosive sign with white lettering identifying it as a sprinkler alarm with instructions to contact the fire department or 911. The strobe horn shall be cULus Listed. Sprinkler Alarm Strobe Horn shall be model SASH12/24.

D. Water-Flow Indicators:

1. Standard: UL 346.
2. Water-Flow Detector: Electrically supervised.
3. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
4. Type: Paddle operated.
5. Pressure Rating: **250 psig**.
6. Design Installation: Horizontal or vertical.

E. Valve Supervisory Switches:

1. Standard: UL 346.
2. Type: Electrically supervised.
3. Components: Single-pole, double-throw switch with normally closed contacts.
4. Design: Signals that controlled valve is in other than fully open position.
5. 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

2.9 NPS 1/2 NPS 1/2 PRESSURE GAGES

- A. Standard: UL 393.
- B. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- C. Pressure Gage Range: 0- to 250-psig minimum.
- D. Label: Include "WATER" label on dial face.

2.10 EXPOSED-TYPE FIRE-DEPARTMENT CONNECTION

- A. Standard: UL 405.
- B. Type: Exposed, projecting, for wall mounting.
- C. Pressure Rating: 175 psig minimum.
- D. Body Material: Corrosion-resistant metal.
- E. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
- F. Caps: Brass, lugged type, with gasket and chain.
- G. Escutcheon Plate: Round, brass, wall type.
- H. Outlet: Back, with pipe threads.
- I. Number of Inlets: Two .
- J. Escutcheon Plate Marking: Similar to "AUTO SPKR ."
- K. Finish: Rough brass or bronze unless otherwise directed by owner or AHJ.
- L. Outlet Size: NPS 4.

2.11 SPECIALTY VALVES

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- B. Pressure Rating:
 - 1. Standard-Pressure Piping Specialty Valves: 175-psig (1200-kPa) minimum.
- C. Body Material: Cast or ductile iron.
- D. Size: Same as connected piping.
- E. End Connections: Flanged or grooved.

- F. Dry-Pipe Valves:
1. Standard: UL 260.
 2. Design: Differential-pressure type.
 3. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
 4. Air-Pressure Maintenance Device:
 5. Standard: UL 260.
 6. Type: Automatic device to maintain minimum air pressure in piping.
 7. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig (95- to 410-kPa) adjustable range, and 300-psig (2070-kPa) outlet pressure.
 8. Air Compressor:
 - a. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
 - b. Motor Horsepower: Fractional.
 - c. Power: 120-V ac, 60 Hz, single phase.
- G. Deluge Valves:
1. Standard: UL 260.
 2. Design: Hydraulically operated, differential-pressure type.
 3. Include trim sets for alarm-test bypass, drain, electrical water-flow alarm switch, pressure gages, drip cup assembly piped without valves and separate from main drain line, and fill-line attachment with strainer.
 4. Dry, Pilot-Line Trim Set: Include dry, pilot-line actuator; air- and water-pressure gages; low-air-pressure warning switch; air relief valve; and actuation device. Dry, pilot-line actuator includes cast-iron, operated, diaphragm-type valve with resilient facing plate, resilient diaphragm, and replaceable bronze seat. Valve includes threaded water and air inlets and water outlet. Loss of air pressure on dry, pilot-line side allows pilot-line actuator to open and causes deluge valve to open immediately.
 5. Air-Pressure Maintenance Device:
 - a. Standard: UL 260.
 - b. Type: Automatic device to maintain minimum air pressure in piping.
 - c. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig (95- to 410-kPa) adjustable range, and 300-psig (2070-kPa) outlet pressure.
 6. Air Compressor:
 7. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
 8. Motor Horsepower: Fractional.
 9. Power: 120-V ac, 60 Hz, single phase.
 10. 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
- H. Automatic (Ball Drip) Drain Valves:
1. Standard: UL 1726.
 2. Pressure Rating: 175-psig (1200-kPa) minimum.
 3. Type: Automatic draining, ball check.
 4. Size: NPS 3/4 (DN 20).
 5. End Connections: Threaded.

2.12 MANUAL CONTROL STATIONS

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide" for hydraulic operation, with union, NPS 1/2 (DN 15) pipe nipple, and bronze ball valve.
- B. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.13 CONTROL PANELS

- A. Description: Single-area, two-area, or single-area cross-zoned type control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves.
 - 1. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide" when used with thermal detectors and Class A detector circuit wiring.
 - 2. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
 - 3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application
- B. Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.
- C. Manual Control Stations: Hydraulic operation, with union, NPS 1/2 (DN 15) pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.
- D. Panels Components:
 - 1. Power supply.
 - 2. Battery charger.
 - 3. Standby batteries.
 - 4. Field-wiring terminal strip.
 - 5. Electrically supervised solenoid valves and polarized fire-alarm bell.
 - 6. Lamp test facility.
 - 7. Single-pole, double-throw auxiliary alarm contacts.
 - 8. Rectifier.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING

- A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements in Section 211100 "Facility Fire-Suppression Water-Service Piping" for exterior piping.
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.3 WATER-SUPPLY CONNECTIONS

- A. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements for interior piping in Section 221116 "Domestic Water Piping."
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-distribution piping.
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

3.4 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
 - 2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.
- C. Install seismic restraints on piping. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes **NPS 2 (DN 50)** and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having **NPS 2-1/2 (DN 65)** and larger end connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

- J. Install automatic (ball drip) drain valves to drain piping between fire department connections and check valves. Drain to floor drain or to outside building.
- K. Connect compressed-air supply to dry-pipe sprinkler piping.
- L. Connect air compressor to the following piping and wiring:
 1. Pressure gages and controls.
 2. Electrical power system.
 3. Fire-alarm devices, including low-pressure alarm.
- M. Install alarm devices in piping systems.
- N. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements in NFPA 13. In seismic-rated areas, refer to Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."
- O. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they are not subject to freezing.
- P. Drain dry-pipe sprinkler piping.
- Q. Pressurize and check dry-pipe sprinkler system piping and air compressors.
- R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.5 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.
- I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- J. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Braze Joints" Chapter.
- K. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- L. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and copper pressure-seal fittings with tools recommended by fitting manufacturer.
- M. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- N. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.6 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
 - 1. Install valves in vertical position for proper direction of flow, in main supply to system.
 - 2. Install dry-pipe and deluge valves with trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

- a. Install air compressor and compressed-air-supply piping.
- b. Install air-pressure maintenance device with shutoff valves to permit servicing without shutting down sprinkler system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with adjustable range; and 175-psig (1200-kPa) maximum inlet pressure.
- c. Install compressed-air-supply piping from building's compressed-air piping system.

3.7 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.
- B. Install sprinklers with water supply from heated space. Do not install pendent or sidewall sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.8 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 4. Energize circuits to electrical equipment and devices.
 5. Start and run air compressors.
 6. Coordinate with fire-alarm tests. Operate as required.
 7. Coordinate with fire-pump tests. Operate as required.
 8. Verify that equipment hose threads are same as local fire department equipment.
- B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.10 CLEANING

- A. Clean dirt and debris from sprinklers.

- B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.11 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.12 PIPING SCHEDULE

- A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends, grooved-end fittings, grooved-end-pipe couplings, and grooved joints.
- B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- C. Standard-pressure, dry-pipe sprinkler system, **NPS 2 (DN 50)** and smaller, shall be the following:
 - 1. Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
- D. Standard-pressure, dry-pipe sprinkler system, **NPS 2-1/2 to NPS 6 (DN 65 to DN 100)**, shall be the following:
 - 1. Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.13 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
 - 1. Rooms without Ceilings: Upright sprinklers.
 - 2. Rooms with Suspended Ceilings: Dry concealed sprinklers.
 - 3. Wall Mounting: Dry sidewall sprinklers.
 - 4. Spaces Subject to Freezing: Upright sprinklers.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
 - 1. Concealed Sprinklers: Rough brass, with factory-painted cover plate to match adjacent surfaces.
 - 2. Flush Sprinklers: Bright chrome, with painted escutcheon to match adjacent surfaces.
 - 3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
 - 4. Upright Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 211316

DIVISION 22

TABLE OF CONTENTS

DIVISION 22 - PLUMBING

220513	COMMON MOTOR REQUIREMENTS
220516	EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
220517	SLEEVES AND SLEEVE SEELS FOR PLUMBING PIPING
220518	ESCUTCHEONS FOR PLUMBING PIPING
220519	METERS AND GAGES FOR PLUMBING PIPING
220523	GENERAL-DUTY VALVES FOR PLUMBING PIPING
220529	HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT
220553	IDENTIFICATION FOR PLUMBING PIPING
220719	PLUMBING PIPING INSULATION
220800	PLUMBING SYSTEMS COMMISSIONING
221116	DOMESTIC WATER PIPING
221119	DOMESTIC WATER PIPING SPECIALTIES
221123	DOMESTIC WATER PUMPS
221316	SANITARY WASTE AND VENT PIPING
221319	SANITARY WASTE PIPING SPECIALTIES
221323	SANITARY WASTE INTERCEPTORS
221513	GENERAL-SERVICE COMPRESSED-AIR PIPING
221519	GENERAL-SERVICE PACKAGED AIR COMPRESSORS AND RECEIVERS
223400	FUEL-FIRED, DOMESTIC-WATER HEATERS
224213.13	COMMERCIAL WATER CLOSETS
224213.16	COMMERCIAL URINALS
224216.13	COMMERCIAL SINKS
224223	COMMERCIAL SHOWERS
224713	DRINKING FOUNTAINS

END OF TABLE OF CONTENTS

SECTION 220513

COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 4500 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.

- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Rotor: Random-wound, squirrel cage.
- F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating.
- H. Insulation: Class F.
- I. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 220513

SECTION 220516

EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rubber union connector packless expansion joints.
2. Flexible-hose packless expansion joints.
3. Externally pressurized metal-bellows packless expansion joints.
4. Alignment guides and anchors.
5. Pipe loops and swing connections.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Delegated-Design Submittal: For each anchor and alignment guide, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
3. Alignment Guide Details: Detail field assembly and attachment to building structure.
4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

2.2 PACKLESS EXPANSION JOINTS

- A. Rubber Union Connector Expansion Joints:
 - 1. Material: Twin reinforced-rubber spheres.
 - 2. Minimum Pressure Rating: 150 psig at 170 deg F (1035 kPa at 77 deg C), unless otherwise indicated.
 - 3. End Connections for NPS 2 (DN 50) and Smaller: Threaded.
- B. Flexible-Hose Packless Expansion Joints:
 - 1. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
 - 2. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
 - 3. Expansion Joints for Copper Tubing NPS 2 (DN 50) and Smaller: Copper-alloy fittings with solder-joint end connections.
 - a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F (3100 kPa at 21 deg C) and 340 psig at 450 deg F (2340 kPa at 232 deg C) ratings.
 - 4. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Copper-alloy fittings with threaded end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F (2070 kPa at 21 deg C) and 225 psig at 450 deg F (1550 kPa at 232 deg C) ratings.
 - 5. Expansion Joints for Steel Piping NPS 2 (DN 50) and Smaller: Carbon-steel fittings with threaded end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig at 70 deg F (3100 kPa at 21 deg C) and 325 psig at 600 deg F (2250 kPa at 315 deg C) ratings.
 - 6. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6 (DN 65 to DN 150): Carbon-steel fittings with flanged end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F (1380 kPa at 21 deg C) and 145 psig at 600 deg F (1000 kPa at 315 deg C) ratings.
- C. Externally Pressurized Metal-Bellows Packless Expansion Joint:
 - 1. Minimum Pressure Rating: 200 psig (1379 kPa), unless otherwise indicated.
 - 2. Description:

- a. Totally enclosed, externally pressurized, multi-ply, stainless-steel bellows isolated from fluid flow by an internal pipe sleeve.
 - b. Carbon-steel housing.
 - c. Drain plugs and lifting lug for **NPS 3 (DN 80)** and larger.
 - d. Bellows shall have operating clearance between the internal pipe sleeves and the external shrouds.
 - e. Joints shall be supplied with a built-in scale to confirm the starting position and operating movement.
 - f. Joint Axial Movement: **6 inches (150 mm)** of compression and **1 inch (25 mm)** of extension.
3. Permanent Locking Bolts: Set locking bolts to maintain joint lengths during installation. Temporary welding tabs that are removed after installation in lieu of locking bolts are not acceptable.
 4. End Connection Configuration: Flanged; one raised, fixed and one floating flange.

2.3 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides :

1. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding slider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
 - a. Stud: Threaded, zinc-coated carbon steel.
 - b. Expansion Plug: Zinc-coated steel.
 - c. Washer and Nut: Zinc-coated steel.
5. Chemical Fasteners: Insert-type stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
 - a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
 - b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
 - c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.1 EXPANSION JOINT INSTALLATION

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.
- B. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."

3.2 PIPE LOOP AND SWING CONNECTION INSTALLATION

- A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Connect risers and branch connections to mains with at least five fittings, including tee in main.
- C. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.
- D. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

- A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
- B. Install one guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.
- C. Attach guides to pipe, and secure guides to building structure.
- D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- E. Anchor Attachments:
 - 1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24; U bolts bolted to anchor.
- F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
 - 1. Anchor Attachment to Steel Structural Members: Attach by welding.
 - 2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
- G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 220516

SECTION 220517

SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Sleeve-seal systems.
 - 3. Grout.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Carbon steel.
 - 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25-mm) annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level.
 - 2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior Concrete Walls above Grade: Galvanized-steel-pipe sleeves.
 - 2. Exterior Concrete Walls below Grade:
 - a. Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 - 3. Concrete Slabs-on-Grade:
 - a. Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 - 4. Concrete Slabs above Grade:
 - a. PVC-pipe sleeves.
 - 5. Interior Partitions:
 - a. Piping Smaller Than NPS 6 (DN 150): PVC-pipe sleeves.
 - b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 220517

SECTION 220518

ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.

- b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.
 - j. Bare Piping in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated finish.
 - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
- 1. New Piping: One-piece, floor-plate type.

3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 220518

SECTION 220519

METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Bimetallic-actuated thermometers.
 - 2. Liquid-in-glass thermometers.
 - 3. Thermowells.
 - 4. Dial-type pressure gages.
 - 5. Gage attachments.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 INFORMATIONAL SUBMITTALS

- A. Product certificates.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 BIMETALLIC-Standard: ASME B40.200.

- A. Case: Liquid-filled and sealed type(s); stainless steel with 3-inch (76-mm) nominal diameter.
- B. Dial: Non-reflective aluminum with permanently etched scale markings and scales in deg F and deg C.
- C. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.
- D. Connector Size: 1/2 inch (13 mm), with ASME B1.1 screw threads.
- E. Stem: 0.25 or 0.375 inch (6.4 or 9.4 mm) in diameter; stainless steel.
- F. Window: Plain glass or plastic.
- G. Ring: Stainless steel.

- H. Element: Bimetal coil.
- I. Pointer: Dark-colored metal.
- J. Accuracy: Plus or minus 1 percent of scale range.

2.2 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
 - 1. Standard: ASME B40.200.
 - 2. Case: Cast aluminum; 9-inch (229-mm) nominal size unless otherwise indicated.
 - 3. Case Form: Adjustable angle unless otherwise indicated.
 - 4. Tube: Glass with magnifying lens and blue or red organic liquid.
 - 5. Tube Background: Non-reflective aluminum with permanently etched scale markings graduated in deg F and deg C.
 - 6. Window: Glass or plastic.
 - 7. Stem: Aluminum and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
 - 8. Connector: 1-1/4 inches (32 mm), with ASME B1.1 screw threads.
 - 9. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.
- B. Plastic-Case, Industrial-Style, Liquid-in-Glass Thermometers:
 - 1. Standard: ASME B40.200.
 - 2. Case: Plastic; 9-inch (229-mm) nominal size unless otherwise indicated.
 - 3. Case Form: Adjustable angle unless otherwise indicated.
 - 4. Tube: Glass with magnifying lens and blue or red organic liquid.
 - 5. Tube Background: Non-reflective aluminum with permanently etched scale markings graduated in deg F and deg C.
 - 6. Window: Glass or plastic.
 - 7. Stem: Aluminum, brass, or stainless steel and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
 - 8. Connector: 1-1/4 inches (32 mm), with ASME B1.1 screw threads.
 - 9. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.3 THERMOWELLS

- A. Thermowells:
 - 1. Standard: ASME B40.200.
 - 2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
 - 3. Material for Use with Copper Tubing: CNR or CUNI.
 - 4. Material for Use with Steel Piping: CRES.
 - 5. Type: Stepped shank unless straight or tapered shank is indicated.
 - 6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, (DN 15, DN 20, or NPS 25,) ASME B1.20.1 pipe threads.

7. Internal Threads: 1/2, 3/4, and 1 inch (13, 19, and 25 mm), with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.4 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Standard: ASME B40.100.
2. Case: Liquid-filled type(s); cast aluminum or drawn steel; 6-inch (152-mm) nominal diameter.
3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
4. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi and kPa.
7. Pointer: Dark-colored metal.
8. Window: Glass or plastic.
9. Ring: Brass.
10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.5 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads.

2.6 METERING

A. Meters capable of the following:

1. Recording daily water consumption.
2. Communicating data remotely.
3. Electronic data storage for five years.
4. Reports showing daily, monthly, and annual water consumption.
5. Alarming capability in accordance with Water User Efficiency Plan for Operation.

B. Meter potable and reclaimed water sources to the building and onsite non-potable water sources individually.

C. Submeter the following:

1. Automatically controlled irrigation systems.
2. Tenant spaces.
3. Makeup-water lines to onsite water collection systems.
4. Makeup-water lines to ornamental water features.
5. Makeup-water lines to indoor and outdoor pools.
6. Makeup-water lines to and blowdown lines from cooling towers.
7. Makeup-water lines to steam boilers.
8. Makeup-water lines to evaporative coolers.
9. Makeup-water lines to open-loop fluid coolers.
10. Makeup-water lines to open-loop chillers.
11. Makeup-water lines to closed-loop systems.
12. Roof spray systems.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
- G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- H. Install remote-mounted pressure gages on panel.
- I. Install valve and snubber in piping for each pressure gage for fluids.
- J. Install thermometers in the following locations:
 1. Inlet and outlet of each water heater.
 2. Inlets and outlets of each domestic water heat exchanger.
 3. Inlet and outlet of each domestic hot-water storage tank.
 4. Inlet and outlet of each remote domestic water chiller.
- K. Install pressure gages in the following locations:
 1. Building water service entrance into building.
 2. Inlet and outlet of each pressure-reducing valve.
 3. Suction and discharge of each domestic water pump.

- L. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.
- M. Adjust faces of meters and gages to proper angle for best visibility.

3.2 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each domestic water heater shall be one of the following:
 - 1. Liquid-filled, bimetallic-actuated type.
 - 2. Industrial-style, liquid-in-glass type.
- B. Thermometers at inlets and outlets of each domestic water heat exchanger shall be one of the following:
 - 1. Liquid-filled, bimetallic-actuated type.
 - 2. Industrial-style, liquid-in-glass type.
- C. Thermometers at inlet and outlet of each domestic hot-water storage tank shall be one of the following:
 - 1. Liquid-filled, bimetallic-actuated type.
 - 2. Industrial-style, liquid-in-glass type.
- D. Thermometers at inlet and outlet of each remote domestic water chiller shall be one of the following:
 - 1. Liquid-filled, bimetallic-actuated type.
 - 2. Industrial-style, liquid-in-glass type.
- E. Thermometer stems shall be of length to match thermowell insertion length.

3.3 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F and minus 20 to plus 50 deg C.
- B. Scale Range for Domestic Hot-Water Piping: 20 to 240 deg F and 0 to 150 deg C.

3.4 PRESSURE-GAGE SCHEDULE

- A. Pressure gages at discharge of each water service into building shall be the following:
 - 1. Liquid-filled, direct-mounted, metal case.
 - 2. Sealed, direct-mounted, plastic case.
- B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be the following:

1. Liquid-filled, direct-mounted, metal case.
2. Sealed, direct-mounted, plastic case.

C. Pressure gages at suction and discharge of each domestic water pump shall be the following:

1. Liquid-filled, direct-mounted, metal case.
2. Sealed, direct-mounted, plastic case.

3.5 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Water Service Piping: 0 to 160 psi and 0 to 1100 kPa.
- B. Scale Range for Domestic Water Piping: 0 to 160 psi and 0 to 1100 kPa.

END OF SECTION 220519

SECTION 220523

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Bronze ball valves.
- B. Related Sections:
 - 1. Section 221116 "Domestic Water Piping" for valves applicable only to this piping.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Handlever: For quarter-turn valves NPS 6 and smaller.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 2. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
 - 1. Solder Joint: With sockets according to ASME B16.18.
 - 2. Threaded: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. NIBCO INC.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball valves.
 - 2. Throttling Service: Ball valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Ball Valves: Two piece, full port, bronze with bronze trim.

END OF SECTION 220523

SECTION 220529

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Metal pipe hangers and supports.
 2. Trapeze pipe hangers.
 3. Thermal-hanger shield inserts.
 4. Fastener systems.
 5. Pipe positioning systems.
 6. Equipment supports.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
1. Trapeze pipe hangers.
 2. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Stainless-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- C. Copper Pipe Hangers:
 - 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
 - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.

- B. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.6 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.7 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Non-staining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- M. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
 - 5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
 - 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and 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. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.

- F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
 - 5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 - 6. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 - 7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 - 8. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
 - 9. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 - 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.

3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- R. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220553

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Equipment labels.
 2. Warning signs and labels.
 3. Pipe labels.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
1. Material and Thickness: aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 2. Letter Color: Black.
 3. Background Color: White.
 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
 6. Fasteners: Stainless-steel rivets or self-tapping screws.
 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
 2. Letter Color: Black.
 3. Background Color: White.
 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for

- greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
 - 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on **8-1/2-by-11-inch** bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, **1/16 inch** thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: White.
- D. Maximum Temperature: Able to withstand temperatures up to **160 deg F**.
- E. Minimum Label Size: Length and width vary for required label content, but not less than **2-1/2 by 3/4 inch**.
- F. Minimum Letter Size: **1/4 inch** for name of units if viewing distance is less than **24 inches**, **1/2 inch** for viewing distances up to **72 inches**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information plus emergency notification instructions.
- J. Pipe Label Color Schedule:
- 1. Low-Pressure Compressed Air Piping:
 - a. Background: Safety blue.
 - b. Letter Colors: White.
 - 2. High-Pressure Compressed Air Piping:
 - a. Background: Safety blue.
 - b. Letter Colors: White.
 - 3. Domestic Water Piping

- a. Background: Safety green.
 - b. Letter Colors: White.
4. Sanitary Waste and Storm Drainage Piping:
- a. Background Color: Safety black.
 - b. Letter Color: White.

END OF SECTION 220553

SECTION 220719

PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating the following plumbing piping services:
 - 1. Domestic hot-water piping.
 - 2. Domestic recirculating hot-water piping.
 - 3. Sanitary waste piping exposed to freezing conditions.
 - 4. Storm-water piping exposed to freezing conditions.
 - 5. Roof drains and rainwater leaders.
 - 6. Supplies and drains for handicap-accessible lavatories and sinks.
- B. Related Sections:
 - 1. Section 220716 "Plumbing Equipment Insulation."

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content and chemical components.
 - 2. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating that product complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 6. Detail application of field-applied jackets.
 - 7. Detail application at linkages of control devices.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- B. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Special-Shaped Insulation: ASTM C 552, Type III.
 - 2. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 - 3. Preformed Pipe Insulation with Factory-Applied: Comply with ASTM C 552, Type II, Class 2.
 - 4. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

- G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
- H. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, without factory-applied jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- I. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

2.3 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. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
 - 1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

F. PVC Jacket Adhesive: Compatible with PVC jacket.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
4. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: 60 percent by volume and 66 percent by weight.
4. Color: White.

2.5 SEALANTS

A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.
4. Color: White or gray.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. FSK and Metal Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.

2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Adhesive: As recommended by jacket material manufacturer.
2. Color: White Color-code jackets based on university system. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

- a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- C. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Same material, finish, and thickness as jacket.
 - b. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - c. Tee covers.
 - d. Flange and union covers.
 - e. End caps.
 - f. Beveled collars.
 - g. Valve covers.
 - h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- D. Underground Direct-Buried Jacket: 125-mil-thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - 1. Width: 3 inches.
 - 2. Thickness: 11.5 mils.
 - 3. Adhesion: 90 ounces force/inch in width.
 - 4. Elongation: 2 percent.
 - 5. Tensile Strength: 40 lbf/inch in width.
 - 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 - 1. Width: 3 inches.
 - 2. Thickness: 6.5 mils.
 - 3. Adhesion: 90 ounces force/inch in width.
 - 4. Elongation: 2 percent.
 - 5. Tensile Strength: 40 lbf/inch in width.
 - 6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
 - 1. Width: 2 inches.
 - 2. Thickness: 6 mils.
 - 3. Adhesion: 64 ounces force/inch in width.
 - 4. Elongation: 500 percent.
 - 5. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Width: 2 inches.
2. Thickness: 3.7 mils.
3. Adhesion: 100 ounces force/inch in width.
4. Elongation: 5 percent.
5. Tensile Strength: 34 lbf/inch in width.

2.10 SECUREMENTS

- A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- C. Wire: 0.080-inch nickel-copper alloy.

2.11 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers,:
 1. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
- B. Protective Shielding Piping Enclosures,:
 1. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Cleanouts.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.4 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Install insulation to flanges as specified for flange insulation application.
 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF MINERAL-FIBER PREFORMED PIPE INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.9 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.10 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.12 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.13 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Hot and Recirculated Hot Water piping up to 1-1/4": Insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1-1/2 inch thick.
 - 2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - 3. Polyolefin: 1-1/2 inch thick.
- B. Domestic Hot and Recirculated Hot Water piping greater than 1-1/4": Insulation shall be one of the following:
 - 1. Flexible Elastomeric: 2 inch thick.
 - 2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.
 - 3. Polyolefin: 2 inch thick.
- C. Domestic Cold Water piping up to 1-1/4": Insulation shall be one of the following:
 - 1. Flexible Elastomeric: 3/4 inch thick.
 - 2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
 - 3. Polyolefin: 3/4 inch thick.
- D. Domestic Cold Water piping greater than 1-1/4": Insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1-1/2 inch thick.
 - 2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - 3. Polyolefin: 1-1/2 inch thick.

- E. Roof Drain Piping: Insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1-1/2 inch thick.
 - 2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - 3. Polyolefin: 1-1/2 inch thick.

3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
 - 1. White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
- D. Piping, Exposed:
 - 1. PVC, Color-Coded by System: 20 mils thick.

3.15 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

3.16 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified by architect.
- B. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

END OF SECTION 220719

SECTION 221116
DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Aboveground domestic water pipes, tubes, and fittings inside buildings.

1.3 ACTION SUBMITTALS

- A. Product Data: For transition fittings and dielectric fittings.

1.4 INFORMATIONAL SUBMITTALS

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

1.5 FIELD CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of water service.
 - 2. Do not interrupt water service without Owner's written permission.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Ordering: Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

1. Store PEX tubing in cartons or under cover to avoid dirt or foreign material from entering the tubing.
2. Do not expose PEX tubing to direct sunlight for more than 30 days. If construction delays are encountered, cover the tubing to prevent exposure to direct sunlight

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14 and NSF 61.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
- B. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- C. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- D. Copper Unions:
 1. MSS SP-123.
 2. Cast-copper-alloy, hexagonal-stock body.
 3. Ball-and-socket, metal-to-metal seating surfaces.
 4. Solder-joint or threaded ends.
- E. Copper Pressure-Seal-Joint Fittings:
 1. Fittings for NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
 2. Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
- F. Copper Push-on-Joint Fittings:
 1. Description:
 - a. Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22.
 - b. Stainless-steel teeth and EPDM-rubber, O-ring seal in each end instead of solder-joint ends.

2.3 CPVC PIPING

- A. CPVC Pipe: ASTM F 441/F 441M, Schedule 40.
 1. CPVC Socket Fittings: ASTM F 438 for Schedule 40.

- 2. CPVC Threaded Fittings: ASTM F 437, Schedule 80.
- B. CPVC Piping System: ASTM D 2846/D 2846M, SDR 11, pipe and socket fittings.
- C. CPVC Tubing System: ASTM D 2846/D 2846M, SDR 11, tube and socket fittings.

2.4 PEX TUBE AND FITTINGS

- A. PEX Distribution System: ASTM F 877, SDR 9 tubing. Fittings in "Fittings for PEX Tube" Paragraph below are available in NPS 3/8 to NPS 1 (DN 10 to DN 25).
- B. PEX Fittings: elbows, adapters, couplings, plugs, tees and multi-port tees (1/2 inch through 3 inch nominal pipe size): ASTM F1960 cold-expansion fitting manufactured from the following material types:
 - 1. UNS No. C69300 Lead-free (LF) Brass.
 - 2. 20% glass-filled polysulfone as specified in ASTM D 6394.
 - 3. Unreinforced polysulfone (group 01, class 1, grade 2) as specified in ASTM D 6394.
 - 4. Polyphenylsulfone (group 03, class 1, grade 2) as specified in ASTM D 6394.
 - 5. Blend of polyphenylsulfone (55-80%) and unreinforced polysulfone (rem.) as specified in ASTM D 6394.
 - 6. Reinforcing cold-expansion rings shall be manufactured from the same source as PEX piping manufacturer and marked "F1960".
- C. Pre-Insulated Piping (1/2 inch (16mm) through 2 inch (50mm) nominal pipe size): PEX piping, with a closed-cell polyethylene foam insulation.
- D. Multi-Port Tees: Multiple-outlet fitting complying with ASTM F 877 (CAN/CSA B137.5); with ASTM F 1960 inlets and outlets.
 - 1. Engineered polymer branch multi-port tee.
 - 2. Engineered polymer flow-through multi-port tee.
 - 3. Engineered polymer commercial branch multi-port tee.
 - 4. Engineered polymer commercial branch multi-port elbow.
 - 5. Engineered polymer commercial flow-through multi-port tee.
- E. Manifolds: Multiple-outlet assembly complying with ASTM F 877 (CAN/CSA B137.5); with ASTM F 1960 outlets.
 - 1. Engineered polymer valved manifold.
 - 2. Engineered polymer valveless manifold.
 - 3. Lead - free copper branch manifold.
 - 4. Lead-free copper valved manifold.
- F. PEX-to-Metal Transition Fittings:
 - 1. Manufacturers: Provide fittings from the same manufacturer of the piping.
 - 2. Threaded Brass to PEX Transition: one-piece brass fitting with male or female threaded adapter and ASTM F 1960 cold-expansion end, with PEX reinforcing cold-expansion ring.
 - 3. Brass Sweat to PEX Transition: one-piece brass fitting with sweat adapter and ASTM F 1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.
 - 4. PEX to Flange Transition: two-piece brass fitting with lead-free ProPEX adapter and steel flange conforming to ASME B 16.5.
- G. PEX-to-Thermoplastic Transition Fittings: CPVC to PEX Transition: Thermoplastic fitting with one spigot or socket end and one ASTM F 1960 cold-expansion end, with PEX reinforcing cold-expansion ring.

H. VALVES

1. PEX-to-PEX, Lead Free (LF) Brass Ball Valves (1/2 inch (16 mm) through 2 inch (50 mm) nominal pipe size)
 - a. Manufacturers: Provide ball valve(s) from the same manufacturer as the piping system.
 - b. Full-port ball valve: two-piece, ASTM F1960 cold-expansion ends, with PEX reinforcing cold-expansion ring.
 - c. LF brass valve with a positive stop shoulder manufactured from C69300 brass.
 - d. In compliance with: 250 CWP, ANSI/NSF 359, ANSI/NSF 14/61, cNSF-us-pw_G lead free 0.25% Lead max., ASTM F1960, ASTM F 877 (CAN/CSA B137.5).

2.5 PVC PIPE AND FITTINGS

- A. PVC Pipe: ASTM D 1785, Schedule 40.
- B. PVC Socket Fittings: ASTM D 2466 for Schedule 40.
- C. PVC Schedule 80 Threaded Fittings: ASTM D 2464.

2.6 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials:
 1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
 2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.'

2.7 TRANSITION FITTINGS

- A. General Requirements:
 1. Same size as pipes to be joined.
 2. Pressure rating at least equal to pipes to be joined.
 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Coupling: AWWA C219.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Cascade Waterworks Manufacturing](#).

- b. [Dresser, Inc.; Piping Specialties Products.](#)
- c. [Ford Meter Box Company, Inc. \(The\).](#)
- d. [JCM Industries.](#)
- e. [Romac Industries, Inc.](#)
- f. [Smith-Blair, Inc.; a Sensus company.](#)
- g. [Viking Johnson.](#)

2.8 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Capitol Manufacturing Company; member of the Phoenix Forge Group.](#)
 - b. [Central Plastics Company.](#)
 - c. [Hart Industries International, Inc.](#)
 - d. [Jomar International.](#)
 - e. [Matco-Norca.](#)
 - f. [McDonald, A. Y. Mfg. Co.](#)
 - g. [Watts; a division of Watts Water Technologies, Inc.](#)
 - h. [Wilkins; a Zurn company.](#)
 - 2. Standard: ASSE 1079.
 - 3. Pressure Rating: 250 psig at 180 deg F.
 - 4. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. 175 psig minimum 150 psig Dielectric Nipples:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Elster Perfection Corporation.](#)
 - b. [Grinnell Mechanical Products; Tyco Fire Products LP.](#)
 - c. [Matco-Norca.](#)
 - d. [Precision Plumbing Products, Inc.](#)
 - e. [Victaulic Company.](#)
 - 2. Standard: IAPMO PS 66.
 - 3. Electroplated steel nipple complying with ASTM F 1545.
 - 4. Pressure Rating and Temperature: 300 psig at 225 deg F.
 - 5. End Connections: Male threaded or grooved.
 - 6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install shutoff valve immediately upstream of each dielectric fitting.
- C. Install domestic water piping level without pitch and plumb.
- D. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- E. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- F. 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.
- G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- H. Install piping to permit valve servicing.
- I. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- J. Install piping free of sags and bends.
- K. Install fittings for changes in direction and branch connections.
- L. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- M. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 230519 "Meters and Gages for Hydronic Piping."
- N. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."
- O. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 230519 "Meters and Gages for Hydronic Piping."

3.2 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. 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.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- F. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.3 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. NPS 1-1/2 to NPS 2 Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.4 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.

3.5 NPS 2-1/2 to NPS 4 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - 3. 100 Feet Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
- F. NPS 2-1/2 to 108 inches 1/2-inch NPS 3 to NPS 5 10 feet 1/2-inch Install supports for vertical copper tubing every 10 feet.
- G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 2. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.7 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 230553 "Identification for Mechanical Piping and Equipment."
- B. Label pressure piping with system operating pressure.

3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Piping Inspections:
 - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.

2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

- c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
- d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

- a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
- b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
- c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
- d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
- e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
- f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.9 ADJUSTING

A. Perform the following adjustments before operation:

- 1. Close drain valves, hydrants, and hose bibbs.
- 2. Open shutoff valves to fully open position.
- 3. Open throttling valves to proper setting.
- 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
- 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
- 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
- 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
- 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.10 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Clean non-potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.11 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and soldered joints.

3.12 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
 - 2. NPS 2 NPS 2-1/2 Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
 - 3. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 221116

BLANK PAGE

SECTION 221119

DOMESTIC WATER PIPING SPECIALTIES

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. Vacuum breakers.
 - 2. Backflow preventers.
 - 3. Water pressure-reducing valves.
 - 4. Balancing valves.
 - 5. Temperature-actuated, water mixing valves.
 - 6. Strainers.
 - 7. Outlet boxes.
 - 8. Hose stations.
 - 9. Hose bibbs.
 - 10. Wall hydrants.
 - 11. Ground hydrants.
 - 12. Post hydrants.
 - 13. Drain valves.
 - 14. Water-hammer arresters.
 - 15. Air vents.
 - 16. Trap-seal primer valves.
 - 17. Trap-seal primer systems.
 - 18. Specialty valves.
 - 19. Flexible connectors.
 - 20. Water meters.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For domestic water piping specialties.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Potable-water piping and components shall comply with NSF 61.

2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
 - 1. Standard: ASSE 1001.
 - 2. Size: NPS 1/4 to NPS 3, as required to match connected piping.
 - 3. Body: Bronze.
 - 4. Inlet and Outlet Connections: Threaded.
- B. Hose-Connection Vacuum Breakers:
 - 1. Standard: ASSE 1011.
 - 2. Body: Bronze, nonremovable, with manual drain.
 - 3. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
- C. Pressure Vacuum Breakers :
 - 1. Standard: ASSE 1020.
 - 2. Operation: Continuous-pressure applications.
 - 3. Pressure Loss: 5 psig maximum, through middle third of flow range.
 - 4. Accessories:
 - a. Valves: Ball type, on inlet and outlet.
- D. Laboratory-Faucet Vacuum Breakers:
 - 1. Standard: ASSE 1035.
 - 2. Size: NPS 1/4 or NPS 3/8 matching faucet size.
 - 3. Body: Bronze.
 - 4. End Connections: Threaded.
 - 5. Finish: Chrome plated.
- E. Spill-Resistant Vacuum Breakers :
 - 1. Standard: ASSE 1056.
 - 2. Operation: Continuous-pressure applications.

3. Accessories:
 - a. Valves: Ball type, on inlet and outlet.

2.4 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers:

1. Standard: ASSE 1012.
2. Operation: Continuous-pressure applications.
3. Body: Bronze.

B. Reduced-Pressure-Principle Backflow Preventers:

1. Standard: ASSE 1013.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 12 psig maximum, through middle third of flow range.
4. Body: Bronze for NPS 2 and smaller; stainless steel for NPS 2-1/2 and larger.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
6. Configuration: Designed for horizontal, straight-through flow.
7. Accessories:
 - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
 - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

C. Double-Check, Backflow-Prevention Assemblies:

1. Standard: ASSE 1015.
2. Operation: Continuous-pressure applications unless otherwise indicated.
3. Pressure Loss: 5 psig maximum, through middle third of flow range.
4. Body: Bronze for NPS 2 and smaller; stainless steel for NPS 2-1/2 and larger.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
6. Configuration: Designed for horizontal, straight-through flow.
7. Accessories:
 - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

D. Beverage-Dispensing-Equipment Backflow Preventers:

1. Standard: ASSE 1022.
2. Operation: Continuous-pressure applications.
3. Size: NPS 1/4 or NPS 3/8.
4. Body: Stainless steel.
5. End Connections: Threaded.

E. Dual-Check-Valve Backflow Preventers:

1. Standard: ASSE 1024.
2. Operation: Continuous-pressure applications.
3. Body: Bronze with union inlet.

F. Carbonated-Beverage-Dispenser, Dual-Check-Valve Backflow Preventers:

1. Standard: ASSE 1032.
2. Operation: Continuous-pressure applications.
3. Size: NPS 1/4 or NPS 3/8.
4. Body: Stainless steel.
5. End Connections: Threaded.

G. Reduced-Pressure-Detector, Fire-Protection, Backflow-Preventer Assemblies:

1. Standard: ASSE 1047 and is FM Global approved or UL listed.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 12 psig maximum, through middle third of flow range.
4. Body: Stainless steel.
5. End Connections: Flanged.
6. Configuration: Designed for horizontal, straight-through flow.
7. Accessories:
 - a. Valves: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
 - c. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

H. Double-Check, Detector-Assembly Backflow Preventers:

1. Standard: ASSE 1048 and is FM Global approved or UL listed.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 5 psig maximum, through middle third of flow range.
4. Body: Stainless steel.
5. End Connections: Flanged.
6. Configuration: Designed for horizontal, straight-through flow.
7. Accessories:
 - a. Valves: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
 - b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

I. Hose-Connection Backflow Preventers:

1. Standard: ASSE 1052.
2. Operation: Up to 10-foot head of water back pressure.
3. Inlet Size: NPS 1/2 or NPS 3/4.
4. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
5. Capacity: At least 3-gpm flow.

J. Backflow-Preventer Test Kits :

1. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.5 WATER PRESSURE-REDUCING VALVES

A. Water Regulators :

1. Standard: ASSE 1003.
2. Pressure Rating: Initial working pressure of 150 psig.
3. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
4. Valves for Booster Heater Water Supply: Include integral bypass.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

B. Water-Control Valves :

1. Description: Pilot-operated, diaphragm-type, single-seated, main water-control valve.
2. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
3. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
 - a. Pattern: Globe-valve design.
 - b. Trim: Stainless steel.
4. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

2.6 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Type: Y-pattern globe valve with two readout ports and memory-setting indicator.
2. Body: Brass or bronze.
3. Size: Same as connected piping, but not larger than NPS 2.
4. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Cast-Iron Calibrated Balancing Valves :

1. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
2. Size: Same as connected piping, but not smaller than NPS 2-1/2.

C. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

D. Memory-Stop Balancing Valves :

1. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 2 or smaller.
4. Body: Copper alloy.
5. Port: Standard or full port.
6. Ball: Chrome-plated brass.
7. Seats and Seals: Replaceable.
8. End Connections: Solder joint or threaded.
9. Handle: Vinyl-covered steel with memory-setting device.

2.7 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices :

1. Standard: ASSE 1017.

2. Pressure Rating: 125 psig.
3. Type: Thermostatically controlled, water mixing valve.
4. Material: Bronze body with corrosion-resistant interior components.
5. Connections: Threaded union inlets and outlet.
6. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
7. Tempered-Water Setting: 110 F

B. Primary, Thermostatic, Water Mixing Valves :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Lawler Manufacturing Company, Inc.
 - c. Leonard Valve Company.
 - d. Powers.
 - e. Symmons Industries, Inc.
 - f. Zurn Industries, LLC.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Type: Exposed-mounted, thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: 110 F
9. Tempered-Water Design Flow Rate: 145 gpm

C. Manifold, Thermostatic, Water Mixing-Valve Assemblies:

1. Description: Factory-fabricated, exposed-mounted, thermostatically controlled, water mixing-valve assembly in three-valve parallel arrangement.
2. Large-Flow Parallel: Thermostatic, water mixing valve and downstream-pressure regulator with pressure gages on inlet and outlet.
3. Intermediate-Flow Parallel: Thermostatic, water mixing valve and downstream-pressure regulator with pressure gages on inlet and outlet.
4. Small-Flow Parallel: Thermostatic, water mixing valve.
5. Thermostatic Mixing Valves: Comply with ASSE 1017. Include check stops on hot- and cold-water inlets and shutoff valve on outlet.
6. Water Regulator(s): Comply with ASSE 1003. Include pressure gage on inlet and outlet.
7. Pressure Rating: 125 psig minimum unless otherwise indicated.

D. Individual-Fixture, Water Tempering Valves:

1. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
2. Pressure Rating: 125 psig minimum unless otherwise indicated.
3. Body: Bronze body with corrosion-resistant interior components.
4. Temperature Control: Adjustable.
5. Inlets and Outlet: Threaded.
6. Finish: Rough or chrome-plated bronze.
7. Tempered-Water Setting: 110 F

- E. Primary Water Tempering Valves:
1. Standard: ASSE 1017, thermostatically controlled, water tempering valve, listed as tempering valve.
 2. Pressure Rating: 125 psig minimum unless otherwise indicated.
 3. Body: Bronze.
 4. Temperature Control: Manual.
 5. Inlets and Outlet: Threaded.

2.8 STRAINERS FOR DOMESTIC WATER PIPING

- A. Y-Pattern Strainers:
1. Pressure Rating: 125 psig minimum unless otherwise indicated.
 2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
 3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 4. Screen: Stainless steel with round perforations unless otherwise indicated.
 5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.033 inch.
 - b. Strainers NPS 2-1/2 to NPS 4: 0.062 inch.
 - c. Strainers NPS 5 and Larger: 0.125 inch.
 6. Drain: Factory-installed, hose-end drain valve.

2.9 OUTLET BOXES

- A. Clothes Washer Outlet Boxes :
1. Mounting: Recessed.
 2. Material and Finish: Enameled-steel, epoxy-painted-steel, or plastic box and faceplate.
 3. Faucet: Combination valved fitting or separate hot- and cold-water valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
 4. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.
 5. Drain: NPS 2 standpipe and P-trap for direct waste connection to drainage piping.
 6. Inlet Hoses: Two 60-inch-long, rubber household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.
 7. Drain Hose: One 48-inch-long, rubber household clothes washer drain hose with hooked end.
- B. Icemaker Outlet Boxes <Insert drawing designation if any>:
1. Mounting: Recessed.
 2. Material and Finish: Enameled-steel, epoxy-painted-steel, or plastic box and faceplate.
 3. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
 4. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

2.10 HOSE STATIONS

A. Single-Temperature-Water Hose Stations:

1. Standard: ASME A112.18.1.
2. Cabinet: Stainless-steel enclosure with exposed valve handle, hose connection, and hose rack. Include thermometer in front.
3. Hose-Rack Material: Stainless steel.
4. Body Material: Bronze.
5. Body Finish: Rough bronze.
6. Mounting: Wall, with reinforcement.
7. Supply Fittings: NPS 3/4 gate, globe, or ball valve and check valve and NPS 3/4 copper, water tubing. Omit check valve if check stop is included with fitting.
8. Hose: Manufacturer's standard, for service fluid, temperature, and pressure; 50 feet long.
9. Nozzle: With hand-squeeze, on-off control.
10. Vacuum Breaker:
 - a. Integral or factory-installed, nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
 - b. Garden-hose thread complying with ASME B1.20.7 on outlet.

B. Hot- and Cold-Water Hose Stations:

1. Standard: ASME A112.18.1.
2. Faucet Type: Blending valve.
3. Cabinet: Stainless-steel enclosure with exposed valve handles, hose connection, and hose rack. Include thermometer in front.
4. Hose-Rack Material: Stainless steel.
5. Body Material: Bronze.
6. Body Finish: Rough bronze.
7. Mounting: Wall, with reinforcement.
8. Supply Fittings: Two NPS 3/4 gate, globe, or ball valves and check valves and NPS 3/4 copper, water tubing. Omit check valves if check stops are included with fitting.
9. Hose: Manufacturer's standard, for service fluid, temperature, and pressure; 50 feet long.
10. Nozzle: With hand-squeeze, on-off control.
11. Vacuum Breaker: Integral or factory-installed, nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052; and garden-hose thread complying with ASME B1.20.7 on outlet.

2.11 HOSE BIBBS

A. Hose Bibbs :

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [Jay R. Smith Mfg. Co.](#)
 - b. [Josam Company.](#)
 - c. [MIFAB, Inc.](#)
 - d. [Watts; a Watts Water Technologies company.](#)
 - e. [Woodford Manufacturing Company.](#)
 - f. [Zurn Industries, LLC.](#)

2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Bronze.
4. Seat: Bronze, replaceable.
5. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig.
8. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Operating key.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.12 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [Jay R. Smith Mfg. Co.](#)
 - b. [Josam Company.](#)
 - c. [MIFAB, Inc.](#)
 - d. [Watts; a Watts Water Technologies company.](#)
 - e. [Woodford Manufacturing Company.](#)
 - f. [Zurn Industries, LLC.](#)
2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounted with cover.
9. Box and Cover Finish: Chrome plated.
10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: Polished nickel bronze.
12. Operating Keys(s): Two with each wall hydrant.

B. Nonfreeze, Hot- and Cold-Water Wall Hydrants:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [Jay R. Smith Mfg. Co.](#)
 - b. [Josam Company.](#)
 - c. [MIFAB, Inc.](#)

- d. [Watts; a Watts Water Technologies company.](#)
 - e. [Woodford Manufacturing Company.](#)
 - f. [Zurn Industries, LLC.](#)
2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
 3. Pressure Rating: 125 psig.
 4. Operation: Loose key.
 5. Casing and Operating Rods: Of length required to match wall thickness. Include wall clamps.
 6. Inlet: NPS 3/4 or NPS 1.
 7. Outlet: Concealed.
 8. Box: Deep, flush mounted with cover.
 9. Box and Cover Finish: Polished nickel bronze.
 10. Vacuum Breaker:
 - a. Nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
 - b. Garden-hose thread complying with ASME B1.20.7 on outlet.
 11. Operating Keys(s): Two with each wall hydrant.
- C. Moderate-Climate Wall Hydrants:
1. [Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following:
 - a. [Jay R. Smith Mfg. Co.](#)
 - b. [Josam Company.](#)
 - c. [MIFAB, Inc.](#)
 - d. [Watts; a Watts Water Technologies company.](#)
 - e. [Woodford Manufacturing Company.](#)
 - f. [Zurn Industries, LLC.](#)
 2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
 3. Pressure Rating: 125 psig.
 4. Operation: Loose key.
 5. Inlet: NPS 3/4 or NPS 1.
 6. Outlet:
 - a. Concealed, with integral vacuum breaker or nonremovable hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
 - b. Garden-hose thread complying with ASME B1.20.7.
 7. Box: Deep, flush mounted with cover.
 8. Box and Cover Finish: Polished nickel bronze.
 9. Outlet:
 - a. Concealed, with integral vacuum breaker or nonremovable hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
 - b. Garden-hose thread complying with ASME B1.20.7.
 10. Nozzle and Wall-Plate Finish: Polished nickel bronze.
 11. Operating Keys(s): Two with each wall hydrant.

D. Vacuum Breaker Wall Hydrants :

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [Jay R. Smith Mfg. Co.](#)
 - b. [Watts; a Watts Water Technologies company.](#)
 - c. [Woodford Manufacturing Company.](#)
 - d. [Zurn Industries, LLC.](#)
2. Standard: ASSE 1019, Type A or Type B.
3. Type: Freeze-resistant, automatic draining with integral air-inlet valve.
4. Classification: Type A, for automatic draining with hose removed or Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
5. Pressure Rating: 125 psig.
6. Operation: Loose key.
7. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
8. Inlet: NPS 1/2 or NPS 3/4.
9. Outlet: Exposed with garden-hose thread complying with ASME B1.20.7.

2.13 GROUND HYDRANTS

A. Nonfreeze Ground Hydrants <Insert drawing designation if any>:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [Jay R. Smith Mfg. Co.](#)
 - b. [Josam Company.](#)
 - c. [MIFAB, Inc.](#)
 - d. [Watts; a Watts Water Technologies company.](#)
 - e. [Woodford Manufacturing Company.](#)
 - f. [Zurn Industries, LLC.](#)
2. Standard: ASME A112.21.3M.
3. Type: Nonfreeze, concealed-outlet ground hydrant with box.
4. Operation: Loose key.
5. Casing and Operating Rod: Of at least length required for burial of valve below frost line.
6. Inlet: NPS 3/4.
7. Outlet: Garden-hose thread complying with ASME B1.20.7.
8. Drain: Designed with hole to drain into ground when shut off.
9. Box: Deep pattern with cover.
10. Box and Cover Finish: Polished nickel bronze.
11. Operating Key(s): Two with each ground hydrant.
12. Vacuum Breaker: ASSE 1011.

2.14 POST HYDRANTS

A. Nonfreeze, Draining-Type Post Hydrants:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [Jay R. Smith Mfg. Co.](#)
 - b. [MIFAB, Inc.](#)
 - c. [Watts; a Watts Water Technologies company.](#)
 - d. [Woodford Manufacturing Company.](#)
 - e. [Zurn Industries, LLC.](#)
2. Standard: ASME A112.21.3M.
3. Type: Nonfreeze, exposed-outlet post hydrant.
4. Operation: Loose key.
5. Casing and Operating Rod: Of at least length required for burial of valve below frost line.
6. Casing: Bronze with casing guard.
7. Inlet: NPS 3/4.
8. Outlet: Garden-hose thread complying with ASME B1.20.7.
9. Drain: Designed with hole to drain into ground when shut off.
10. Vacuum Breaker:
 - a. Nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
 - b. Garden-hose thread complying with ASME B1.20.7 on outlet.
11. Operating Key(s): Two with each loose-key-operation wall hydrant.

B. Nonfreeze, Nondraining-Type Post Hydrants:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [Jay R. Smith Mfg. Co.](#)
 - b. [MIFAB, Inc.](#)
 - c. [Watts; a Watts Water Technologies company.](#)
 - d. [Woodford Manufacturing Company.](#)
 - e. [Zurn Industries, LLC.](#)
2. Operation: Lever-piston operating mechanism and nondraining water-storage reservoir, designed without drain.
3. Length: As required for burial of valve below frost line.
4. Inlet: NPS 1 threaded.
5. Outlet:
 - a. NPS 1 (DN 25) outlet and coupling plug for 1-inch (25-mm) hose.
 - b. NPS 1 by NPS 3/4 (DN 25 by DN 20) adapter with nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
 - c. Garden-hose thread complying with ASME B1.20.7 on outlet.
 - d. NPS 1 by NPS 3/4 (DN 25 by DN 20) adapter with nonremovable, drainable, hose-connection backflow preventer complying with ASSE 1052.
 - e. Garden-hose thread complying with ASME B1.20.7 on outlet.

C. Freeze-Resistant Sanitary Yard Hydrants:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

- a. [Jay R. Smith Mfg. Co.](#)
 - b. [MIFAB, Inc.](#)
 - c. [Watts; a Watts Water Technologies company.](#)
 - d. [Woodford Manufacturing Company.](#)
 - e. [Zurn Industries, LLC.](#)
2. Standard: ASSE 1057, Type 5 for nondraining hydrants.
 3. Operation: Wheel handle.
 4. Head: Copper alloy, with pail hook.
 5. Inlet: NPS 3/4-inch (DN 20) threaded inlet and inlet nozzle, galvanized-steel riser, and venturi.
 6. Canister: Zinc-plated steel with atmospheric-vent device.
 7. Vacuum Breaker:
 - a. Removable hose-connection backflow preventer complying with ASSE 1052.
 - b. Garden-hose thread complying with ASME B1.20.7 on outlet for field installation.

2.15 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
3. Size: NPS 3/4 (DN 20).
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Gate-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-80 for gate valves.
2. Pressure Rating: Class 125.
3. Size: NPS 3/4 (DN 20).
4. Body: ASTM B 62 bronze.
5. Inlet: NPS 3/4 (DN 20) threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

C. Stop-and-Waste Drain Valves <Insert drawing designation if any>:

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig (1380-kPa) minimum CWP or Class 125.
3. Size: NPS 3/4 (DN 20).
4. Body: Copper alloy or ASTM B 62 bronze.
5. Drain: NPS 1/8 (DN 6) side outlet with cap.

2.16 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters :

1. Standard: ASSE 1010 or PDI-WH 201.
2. Type: Metal bellows or Copper tube with piston.
3. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.17 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating and Temperature: 125-psig (860-kPa) minimum pressure rating at 140 deg F (60 deg C).
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 1/2 (DN 15) minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents:

1. Body: Stainless steel.
2. Pressure Rating: 150-psig (1035-kPa) minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 (DN 10) minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

2.18 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:

1. Standard: ASSE 1018.
2. Pressure Rating: 125 psig (860 kPa) minimum.
3. Body: Bronze.
4. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
5. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
6. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Device:

1. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 (DN 10) minimum, trap makeup connection.
2. Size: NPS 1-1/4 (DN 32) minimum.
3. Material: Chrome-plated, cast brass.

2.19 TRAP-SEAL PRIMER SYSTEMS

A. Trap-Seal Primer Systems :

1. Standard: ASSE 1044.
2. Piping: NPS 3/4, ASTM B 88, Type L (DN 20, ASTM B 88M, Type B); copper, water tubing.
3. Cabinet: Recessed-mounted steel box with stainless-steel cover.

4. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
 - 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.
5. Vacuum Breaker: ASSE 1001.
6. Number Outlets: Eight.
7. Size Outlets: NPS 1/2 (DN 15).

2.20 SPECIALTY VALVES

- A. Comply with requirements for general-duty metal valves in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."

2.21 FLEXIBLE CONNECTORS

- A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 1. Working-Pressure Rating: Minimum 200 psig (1380 kPa).
 2. End Connections NPS 2 (DN 50) and Smaller: Threaded copper pipe or plain-end copper tube.
 3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged copper alloy.
- B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
 1. Working-Pressure Rating: Minimum 200 psig (1380 kPa).
 2. End Connections NPS 2 (DN 50) and Smaller: Threaded steel-pipe nipple.
 3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged steel nipple.

2.22 WATER METERS

- A. Displacement-Type Water Meters:
 1. Description:
 - a. Standard: AWWA C700.
 - b. Pressure Rating: 150-psig (1035-kPa) working pressure.
 - c. Body Design: Nutating disc; totalization meter.
 - d. Registration: In gallons (liters) or cubic feet (cubic meters) as required by utility company.
 - e. Case: Bronze.
 - f. End Connections: Threaded.
- B. Turbine-Type Water Meters:
 1. Description:
 - a. Standard: AWWA C701.

- b. Pressure Rating: 150-psig (1035-kPa) working pressure.
- c. Body Design: Turbine; totalization meter.
- d. Registration: In gallons (liters) or cubic feet (cubic meters) as required by utility company.
- e. Case: Bronze.
- f. End Connections for Meters NPS 2 (DN 50) and Smaller: Threaded.
- g. End Connections for Meters NPS 2-1/2 (DN 65) and Larger: Flanged.

C. Compound-Type Water Meters:

1. Description:

- a. Standard: AWWA C702.
- b. Pressure Rating: 150-psig (1035-kPa) working pressure.
- c. Body Design: With integral mainline and bypass meters; totalization meter.
- d. Registration: In gallons (liters) or cubic feet (cubic meters) as required by utility company.
- e. Case: Bronze.
- f. Pipe Connections: Flanged.

D. Remote Registration System: Direct-reading type complying with AWWA C706; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

E. Remote Registration System: Encoder type complying with AWWA C707; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install Y-pattern strainers for water on supply side of each control valve and pump.
- B. Install air vents at high points of water piping.

3.2 FIELD QUALITY CONTROL

- A. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- B. Prepare test and inspection reports.

END OF SECTION 221119

SECTION 221123
DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. In-line, sealless centrifugal pumps.
- B. Related Sections include the following:
 - 1. Section 221123.13 "Domestic-Water Packaged Booster Pumps" for booster systems.
 - 2. Section 332100 "Water Supply Wells" for well pumps.

1.3 DEFINITIONS

- A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. LEED Submittals:
 - 1. Product Data for Prerequisite EA 2: Documentation indicating that units comply with applicable requirements in ASHRAE/IESNA 90.1, without amendments, Section 7 - "Service Water Heating."

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water pumps to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with pump manufacturer's written rigging instructions for handling.

1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 IN-LINE, SEALLESS CENTRIFUGAL PUMPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Armstrong Pumps, Inc.
 - 2. Bell & Gossett; a Xylem brand.
 - 3. Grundfos Pumps Corp.
 - 4. TACO Incorporated.
 - 5. WILO USA LLC - WILO Canada Inc.
- B. Description: Factory-assembled and -tested, in-line, close-coupled, canned-motor, sealless, overhung-impeller centrifugal pumps.
- C. Pump Construction:
 - 1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
 - 2. Casing: Bronze, with threaded or companion-flange connections.
 - 3. Impeller: Plastic.
 - 4. Motor: Single speed, unless otherwise indicated.
- D. Capacities and Characteristics: See Drawings
 - 1. Minimum Working Pressure: 125 psig.
 - 2. Maximum Continuous Operating Temperature: 220 deg F.
 - 3. Electrical Characteristics:
 - a. Volts: 120.
 - b. Phases: Single.

- c. Hertz: 60.

2.2 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.3 CONTROLS

- A. Thermostats: Electric; adjustable for control of hot-water circulation pump with time clock. Run time 1 hour before and after occupied schedule
 - 1. Type: Water-immersion temperature sensor, for installation in piping.
 - 2. Range: 65 to 200 deg F.
 - 3. Enclosure: NEMA 250, Type 4X.
 - 4. Operation of Pump: On or off.
 - 5. Transformer: Provide if required.
 - 6. Settings (110 Degree Recirc Pump): Start pump at 105 deg F and stop pump at 120 deg F.
 - 7. Settings (165 Degree Recirc Pump): Start pump at 155 deg F and stop pump at 160 deg F.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.2 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Install in-line, sealless centrifugal pumps with shaft horizontal unless otherwise indicated.
- C. Install horizontally mounted, in-line, centrifugal pumps with shaft(s) horizontal.
- D. Install vertically mounted, in-line, close-coupled centrifugal pumps with shaft vertical.
- E. Install continuous-thread hanger rods and spring hangers with vertical-limit stop of size required to support pump weight.
 - 1. Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment." Fabricate brackets or supports as required.

2. Comply with requirements for hangers and supports specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

- F. Install thermostats in hot-water return piping.

3.3 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Install piping adjacent to pumps to allow service and maintenance.

- C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.

1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:

- a. Horizontally mounted, in-line, separately coupled centrifugal pumps.
- b. Horizontally mounted, in-line, close-coupled centrifugal pumps.
- c. Vertically mounted, in-line, close-coupled centrifugal pumps.
- d. Comply with requirements for flexible connectors specified in Section 221116 "Domestic Water Piping."

- D. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for valves specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping," and comply with requirements for strainers specified in Section 221119 "Domestic Water Piping Specialties."

1. Install pressure gage and snubber at suction of each pump and pressure gage and snubber at discharge of each pump. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Comply with requirements for pressure gages and snubbers specified in Section 220519 "Meters and Gages for Plumbing Piping."

- E. Connect pressure switches, thermostats, time-delay relays, and timers to pumps that they control.

- F. Interlock pump between water heater and hot-water storage tank with water heater burner and time-delay relay.

3.4 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.5 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. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Set thermostats, for automatic starting and stopping operation of pumps.
5. Perform the following startup checks for each pump before starting:
 - a. Verify bearing lubrication.
 - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - c. Verify that pump is rotating in the correct direction.
6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
7. Start motor.
8. Open discharge valve slowly.
9. Adjust temperature settings on thermostats.
10. Adjust timer settings.

3.6 ADJUSTING

- A. Adjust domestic water pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust initial temperature set points.
- C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION 221123

SECTION 221316

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.

B. Related Section:

1. Section 221313 "Facility Sanitary Sewers" for sanitary sewerage piping and structures outside the building.

1.2 PERFORMANCE REQUIREMENTS

- ###### A. Seismic Performance:
- Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.3 ACTION SUBMITTALS

- ###### A. Product Data:
- For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

- ###### A. Seismic Qualification Certificates:
- For waste and vent piping, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.

- ###### B. Field quality-control reports.

1.5 QUALITY ASSURANCE

- ###### A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

- ###### B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, class.
- B. Gaskets: ASTM C 564, rubber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:
 - 1. Standards: ASTM C 1277 and CISPI 310.
 - 2. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- C. Heavy-Duty, Hubless-Piping Couplings:
 - 1. Standards: ASTM C 1277 and ASTM C 1540.
 - 2. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 STAINLESS-STEEL PIPE AND FITTINGS

- A. Pipe and Fittings: ASME A112.3.1, drainage pattern with socket and spigot ends.
- B. Internal Sealing Rings: Elastomeric gaskets shaped to fit socket groove.

2.5 ABS PIPE AND FITTINGS

- A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.
- B. Solid-Wall ABS Pipe: ASTM D 2661, Schedule 40.
- C. Cellular-Core ABS Pipe: ASTM F 628, Schedule 40.
- D. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.
- E. Solvent Cement: ASTM D 2235.

2.6 PVC PIPE AND FITTINGS

- A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.
- B. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- C. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.
- D. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- E. Adhesive Primer: ASTM F 656.
- F. Solvent Cement: ASTM D 2564.

2.7 COPPER TUBE AND FITTINGS

- A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
- B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- C. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
 - 1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- D. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.8 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
 - 1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
 - 2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
 - 3. Unshielded, Non-pressure Transition Couplings:
 - a. Standard: ASTM C 1173.
 - b. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - c. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - 2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.

- 3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
4. Shielded, Non-pressure Transition Couplings:
 - a. Standard: ASTM C 1460.
 - b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."
- B. Provide a minimum of 6" sand bedding below all below grade piping. Provide backfill free of boulders larger than two (2") inches. Compact and test all backfill according to ASTM compaction standards or provide pea gravel backfill.
- C. Provide a minimum trench width of not less than 1.5 times the pipe outside diameter plus 12 inches for all below grade piping.

3.2 PIPING INSTALLATION

- A. 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 coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping at indicated slopes.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

- I. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- J. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- K. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for all piping.
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- L. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- M. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- N. Plumbing Specialties:
 - 1. Install backwater valves in sanitary waste gravity-flow piping. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 3. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
- O. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- C. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- D. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in OD's.
 - 2. In Drainage Piping: Unshielded, non-pressure transition couplings.

3.5 VALVE INSTALLATION

- A. Backwater Valves: Install backwater valves in piping subject to backflow.
 - 1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
 - 2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
 - 3. Install backwater valves in accessible locations.
 - 4. Comply with requirements for backwater valve specified in Section 221319 "Sanitary Waste Piping Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 - 2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
 - 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 - 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
 - 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 6. Install individual, straight, horizontal piping runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 8. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
 - D. Support vertical piping and tubing at base and at each floor.
 - E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
 - F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 2. NPS 3: 60 inches with 1/2-inch rod.
 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
 5. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
 - G. Install supports for vertical cast-iron soil piping every 15 feet.
 - H. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 2 (DN 50): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 2. NPS 3 (DN 80): 96 inches (2400 mm) with 1/2-inch (13-mm) rod.
 3. NPS 4 (DN 100): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
 4. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
 - I. Install supports for vertical stainless-steel piping every 10 feet (3 m).
 - J. Install hangers for ABS and PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 4. NPS 6 and NPS 8 (DN 150 and DN 200): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
 5. NPS 10 and NPS 12 (DN 250 and DN 300): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
 - K. Install supports for vertical ABS and PVC piping every 48 inches (1200 mm).
 - L. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/4: 72 inches with 3/8-inch rod.
 2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 3. NPS 2-1/2: 108 inches with 1/2-inch rod.
 4. NPS 3 and NPS 5: 10 feet with 1/2-inch rod.

5. NPS 6: 10 feet with 5/8-inch rod.
6. NPS 8: 10 feet with 3/4-inch rod.

- M. Install supports for vertical copper tubing every 10 feet.
- N. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 5. Install horizontal backwater valves with cleanout cover flush with floor.
 6. Comply with requirements for backwater valves cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
 7. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. 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.

3.8 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 6. Prepare reports for tests and required corrective action.
- E. Do not expose ABS or PVC piping to direct sunlight for more than 30 days. If construction delays are encountered, provide cover to portions of piping exposed to direct sunlight.

3.10 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed ABS and PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.
- E. Repair damage to adjacent materials caused by waste and vent piping installation.

3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
 - 3. Copper DWV tube, copper drainage fittings, and soldered joints.
 - 4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - a. When used in plenum returns piping to be completely enclosed in insulation that meets the flame spread index of not more than 25 and a smoke-developed index of not more than 50.
 - 5. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
 - a. When used in plenum returns piping to be completely enclosed in insulation that meets the flame spread index of not more than 25 and a smoke-developed index of not more than 50.
- C. Underground, soil, waste, and vent piping shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
 - 3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 4. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.

END OF SECTION 221316

SECTION 221319

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backwater valves.
2. Cleanouts.
3. Floor drains.
4. Trench drains.
5. Channel drainage systems.
6. Air-admittance valves.
7. Roof flashing assemblies.
8. Miscellaneous sanitary drainage piping specialties.
9. Flashing materials.

1.2 ACTION SUBMITTALS

- ###### A. Product Data:
- For each type of product indicated. Include rated capacities, operating characteristics, and accessories for grease interceptors.

1.3 QUALITY ASSURANCE

- ###### A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 BACKWATER VALVES

A. Horizontal, Cast-Iron Backwater Valves:

1. Standard: ASME A112.14.1.
2. Size: Same as connected piping.
3. Body: Cast iron.
4. Cover: Cast iron with bolted or threaded access check valve.
5. End Connections: Hub and spigot or hubless.
6. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang open for airflow unless subject to backflow condition.
7. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

B. Drain-Outlet Backwater Valves:

1. Size: Same as floor drain outlet.
2. Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
3. Check Valve: Removable ball float.
4. Inlet: Threaded.
5. Outlet: Threaded or spigot.

2.2 CLEANOUTS

A. Exposed Cast-Iron Cleanouts:

1. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
2. Size: Same as connected drainage piping
3. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
4. Closure: Countersunk or raised-head, brass plug.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Floor Cleanouts:

1. Standard: ASME A112.36.2M for adjustable housing cleanout.
2. Size: Same as connected branch.
3. Type: Adjustable housing.
4. Body or Ferrule: Cast iron.
5. Clamping Device: Required.
6. Outlet Connection: Spigot.
7. Closure: Brass plug with straight threads and gasket.
8. Adjustable Housing Material: Cast iron with threads.
9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
10. Frame and Cover Shape: Round.
11. Top Loading Classification: Heavy Duty.
12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Standard: ASME A112.36.2M. Include wall access.
2. Size: Same as connected drainage piping.
3. Body: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
4. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.3 FLOOR DRAINS

A. Cast-Iron Floor Drains (FD)

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.

- b. [MIFAB, Inc.](#)
 - c. [Smith, Jay R. Mfg. Co.](#)
 - d. [Watts; a Watts Water Technologies company.](#)
 - e. [Zurn Industries, LLC.](#)
2. Standard: ASME A112.6.3.
 3. Pattern: Floor drain.
 4. Body Material: Gray iron.
 5. Top of Body and Strainer Finish: Nickel bronze.
 6. Top Shape: Square
 7. Dimensions of Top or Strainer: 6"
 8. Trap Features: Provide with trap guard.

2.4 TRENCH DRAINS

A. Trench Drains :

1. [Manufacturers](#): Subject to compliance with requirements, provide products by one of the following:
 - a. [Jay R. Smith Mfg. Co.](#)
 - b. [Josam Company.](#)
 - c. [MIFAB, Inc.](#)
 - d. [Watts; a Watts Water Technologies company.](#)
 - e. [Zurn Industries, LLC.](#)
2. Standard: ASME A112.6.3 for trench drains.
3. Material: Ductile or gray iron.
4. Flange: Anchor.
5. Clamping Device: Required.
6. Outlet: Bottom.
7. Grate Material: Ductile iron or gray iron.
8. Grate Finish: Painted.
9. Top Loading Classification: Heavy Duty.
10. Trap Material: Cast iron.
11. Trap Pattern: Standard P-trap.

2.5 CHANNEL DRAINAGE SYSTEMS

A. Stainless-Steel Channel Drainage Systems :

1. ASME A112.3.1, Stainless-Steel Channel Drainage Systems:
2. Non-ASME A112.3.1, Stainless-Steel Channel Drainage Systems:
3. Type: Modular system of stainless-steel channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.

- a. Standard: ASME A112.3.1, for trench drains.
 - b. Channel Sections: Interlocking-joint, stainless-steel with level invert.
 - c. Grates: Manufacturer's designation "heavy duty," with slots or perforations, and of width and thickness that fit recesses in channels.
 - 1) Material: Stainless steel.
 - 2) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.
 - d. Covers: Solid stainless steel, of width and thickness that fit recesses in channels, and of lengths indicated.
 - e. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
 - f. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.
4. Type: Modular system of stainless-steel channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
- a. Channel Sections: Interlocking-joint, stainless steel with level invert.
 - b. Grates: Manufacturer's designation "heavy duty," with slots or perforations, and of width and thickness that fit recesses in channels.
 - 1) Material: Stainless steel.
 - 2) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.
 - c. Covers: Solid stainless steel, of width and thickness that fit recesses in channels, and of lengths indicated.
 - d. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
 - e. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

B. Polymer-Concrete Channel Drainage Systems:

- 1. Narrow, Sloped-Invert, Polymer-Concrete Channel Drainage Systems:
- 2. Narrow, Level-Invert, Polymer-Concrete Channel Drainage Systems:
- 3. Wide, Level-Invert, Polymer-Concrete Channel Drainage Systems:
- 4. Type: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
 - a. Channel Sections: Narrow, interlocking-joint, sloped-invert, polymer-concrete modular units with end caps. Include rounded bottom, with built-in invert slope of 0.6 percent and with outlets in number, sizes, and locations indicated. Include extension sections necessary for required depth.

- 1) Dimensions: 4-inch inside width. Include number of units required to form total lengths indicated.
 - 2) Frame: Gray-iron or galvanized steel for grates.
- b. Grates: Manufacturer's designation "heavy duty," with slots or perforations, and of width and thickness that fit recesses in channel sections.
 - c. Covers: Solid ductile or gray iron, of width and thickness that fit recesses in channel sections, and of lengths indicated.
 - d. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
 - e. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.
 - f. Channel Sections: Narrow, interlocking-joint, precast, polymer-concrete modular units with end caps. Include rounded bottom, with level invert and with NPS 4 outlets in number and locations indicated.
 - 1) Frame: Gray-iron or galvanized steel for grates.
 - g. Grates: Manufacturer's designation "heavy duty," with slots or perforations, and of width and thickness that fit recesses in channel sections.
 - h. Covers: Solid ductile or gray iron, of width and thickness that fit recesses in channel sections, and of lengths indicated.
 - i. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
 - j. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.
 - k. Channel Sections: Wide, interlocking-joint, precast, polymer-concrete modular units with end caps. Include flat or rounded bottom, with level invert and with outlets in number, sizes, and locations indicated.
 - l. Grates: Manufacturer's designation "heavy duty," with slots or perforations, and of width and thickness that fit recesses in channel sections.
 - m. Covers: Solid ductile or gray iron, of width and thickness that fit recesses in channel sections, and of lengths indicated.
 - n. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
 - o. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

2.6 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Description: Manufactured assembly made of 6.0-lb/sq. ft., 0.0938-inch-thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
 - a. Low-Silhouette Vent Cap: With vandal-proof vent cap.

2.7 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

B. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

2.8 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

B. Fasteners: Metal compatible with material and substrate being fastened.

C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

D. Solder: ASTM B 32, lead-free alloy.

E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
 - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- H. Install deep-seal traps on floor drains and other waste outlets.
- I. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 - 2. Size: Same as floor drain inlet.
- J. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- K. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- L. Install vent caps on each vent pipe passing through roof.
- M. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
 - 1. Above-Floor Installation: Set unit with bottom resting on floor, unless otherwise indicated.
 - 2. Flush with Floor Installation: Set unit and extension, if required, with cover flush with finished floor.

3. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.
 4. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.
- N. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

- A. Comply with requirements in Section 22 13 16 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Grease Interceptors: Connect inlet and outlet to unit, and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 07 62 00 "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

3.4 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each grease interceptor.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.5 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 13 19

SECTION 221323

SANITARY WASTE INTERCEPTORS

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. Grease interceptors.
 - 2. Oil interceptors.
 - 3. Sand interceptors.

1.3 DEFINITIONS

- A. FRP: Fiberglass-reinforced plastic.
- B. PP: Polypropylene plastic.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of metal and plastic interceptor indicated. Include materials of fabrication, dimensions, rated capacities, retention capacities, operating characteristics, size and location of each pipe connection, furnished specialties, and accessories.
- B. Shop Drawings: For each type and size of precast-concrete interceptor indicated.
 - 1. Include materials of construction, dimensions, rated capacities, retention capacities, location and size of each pipe connection, furnished specialties, and accessories.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Interceptors, drawn to scale, on which the following items are shown and coordinated with each other, based on input from Installers of the items involved:
 - 1. Interceptors.
 - 2. Piping connections. Include size, location, and elevation of each.
 - 3. Interface with underground structures and utility services.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Sewer Services: Do not interrupt services to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sewer services according to requirements indicated:
1. Notify Owner no fewer than seven days in advance of proposed interruption of service.
 2. Do not proceed with interruption of sewer services without Owner's written permission.

PART 2 - PRODUCTS

2.1 GREASE INTERCEPTORS

- A. Grease Interceptors: Precast concrete complying with ASTM C 913.
1. Include rubber-gasketed joints, vent connections, manholes, compartments or baffles, and piping or openings to retain grease and to permit wastewater flow.
 2. Structural Design Loads:
 - a. Light-Traffic Load: Comply with ASTM C 890, A-8 (ASSHTO HS10-44).
 - b. Medium-Traffic Load: Comply with ASTM C 890, A-12 (ASSHTO HS15-44).
 - c. Heavy-Traffic Load: Comply with ASTM C 890, A-16 (ASSHTO HS20-44).
 - d. Walkway Load: Comply with ASTM C 890, A-03.
 3. Resilient Pipe Connectors: ASTM C 923, cast or fitted into interceptor walls, for each pipe connection.
 4. Steps: Individual FRP steps or FRP ladder, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of interceptor to finished grade is less than 36".
 5. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
 6. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange and 26-inch-diameter cover.
 - a. Ductile Iron: ASTM A 536, Grade 60-40-18, unless otherwise indicated.
 - b. Gray Iron: ASTM A 48, Class 35, unless otherwise indicated.
 - c. Include indented top design with lettering cast into cover, using wording equivalent to "GREASE INTERCEPTOR."
 7. Capacities and Characteristics: See Drawings
- B. Grease Interceptors: Hydromechanical grease interceptor for all applications – indoor or outdoor, above or below grade.
1. Description: Seamless, rotationally-molded polyethylene hydromechanical grease interceptor with minimum 3/8" uniform wall thickness, built-in flow control, built in test/sealing caps and three outlet options.
 2. Risers: Utilize field cut riser system
 3. Cover: Water and gas tight, traffic rated.
 4. Installation Locations: Above or below grade installation.
 5. Standard: Interceptor shall be built in accordance to ASME A112.14.3 (type C) and CSA B481.1,
 6. Warranty : lifetime
 7. Manufacture location: USA

2.2 OIL INTERCEPTORS

- A. Oil Interceptors: Precast concrete comply with ASTM C 913.
1. Include rubber-gasketed joints, vent connections, manholes, compartments or baffles, and piping or openings to retain grease and to permit wastewater flow.
 2. Structural Design Loads:
 - a. Light-Traffic Load: Comply with ASTM C 890, A-8 (ASSHTO HS10-44).
 - b. Medium-Traffic Load: Comply with ASTM C 890, A-12 (ASSHTO HS15-44).
 - c. Heavy-Traffic Load: Comply with ASTM C 890, A-16 (ASSHTO HS20-44).
 - d. Walkway Load: Comply with ASTM C 890, A-03.
 3. Resilient Pipe Connectors: ASTM C 923, cast or fitted into interceptor walls, for each pipe connection.
 4. Steps: Individual FRP steps or FRP ladder, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of interceptor to finished grade is less than 36".
 5. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
 6. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange and 26-inch-diameter cover.
 - a. Ductile Iron: ASTM A 536, Grade 60-40-18, unless otherwise indicated.
 - b. Gray Iron: ASTM A 48, Class 35, unless otherwise indicated.
 - c. Include indented top design with lettering cast into cover, using wording equivalent to " OIL INTERCEPTOR."
 7. Waste-oil storage tank and piping are specified in Section 231113 "Facility Fuel-Oil Piping."
- B. Oil Interceptors: Factory-fabricated, cast-iron or steel body; with removable sediment bucket or strainer, baffles, vents, and flow-control fitting on inlet.
1. Inlet, Outlet, Vent, and Waste-Oil Outlet Piping Connections: Hub, hubless, or threaded, unless otherwise indicated.
 2. Extension: Cast-iron or steel shroud, full size of interceptor, extending from top of interceptor to grade.
 3. Cover: Cast iron or steel, with steel reinforcement to provide ASTM C 890, A-03, walkway load.
 4. Comply with requirements in Section 231113 "Facility Fuel-Oil Piping" for waste-oil storage tank and piping
- C. Oil Interceptors: Plastic oil interceptor for all applications – indoor or outdoor, above or below grade.
1. Description: Seamless, rotationally-molded High Density Polyethylene with minimum 3/8" uniform wall thickness, built-in flow control, vent connections and optional oil draw-off for connection to independent collection tank.
 2. Risers: Utilize field cut riser system
 3. Cover: Water and gas tight, traffic rated.
 4. Installation Locations: Above or below grade installation.
 5. Warranty : lifetime
 6. Manufacture location: USA

- D. Capacities and Characteristics: See Drawings

2.3 SAND INTERCEPTORS

- A. Description: Factory-fabricated, cast-iron or steel body and inlet grate; with settlement chamber and removable basket or strainer.
- B. Outlet Piping Connection: Hub, hubless, or threaded, unless otherwise indicated.
- C. Grate: Cast iron or steel with reinforcement to provide ASTM C 890, A-03, walkway load.
- D. Capacities and Characteristics: See Drawings

2.4 PRECAST-CONCRETE MANHOLE RISERS

- A. Precast-Concrete Manhole Risers: ASTM C 478, with rubber-gasket joints.
 - 1. Structural Design Loads:
 - a. Light-Traffic Load: Comply with ASTM C 890, A-8 (ASSHTO HS10-44).
 - b. Medium-Traffic Load: Comply with ASTM C 890, A-12 (ASSHTO HS15-44).
 - c. Heavy-Traffic Load: Comply with ASTM C 890, A-16 (ASSHTO HS20-44).
 - d. Walkway Load: Comply with ASTM C 890, A-03.
 - 2. Length: From top of underground concrete structure to grade.
 - 3. Riser Sections: 3-inch minimum thickness and [36-inch] <Insert dimension> diameter.
 - 4. Top Section: Eccentric cone, unless otherwise indicated. Include top of cone to match grade ring size.
 - 5. Gaskets: ASTM C 443, rubber.
 - 6. Steps: Individual FRP steps or FRP ladder, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals.
- B. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, diameter matching manhole frame and cover, and height as required to adjust the manhole frame and cover to indicated elevation and slope.
- C. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange and 26-inch-diameter cover.
 - 1. Ductile Iron: ASTM A 536, Grade 60-40-18, unless otherwise indicated.
 - 2. Gray Iron: ASTM A 48, Class 35, unless otherwise indicated.
 - 3. Include indented top design with lettering cast into cover, using wording equivalent to the following:
 - a. Grease Interceptors in Sanitary Sewerage System: " GREASE INTERCEPTOR."
 - b. Oil Interceptors in Sanitary Sewerage System: " OIL INTERCEPTOR."

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 INSTALLATION

- A. Install precast-concrete interceptors according to ASTM C 891. Set level and plumb.
- B. Install manhole risers from top of underground concrete interceptors to manholes and gratings at finished grade.
- C. Set tops of manhole frames and covers flush with finished surface in pavements. Set tops 3 inches above finish surface elsewhere, unless otherwise indicated.
- D. Set tops of grating frames and grates flush with finished surface.
- E. Set metal and plastic interceptors level and plumb.
- F. Set tops of metal interceptor covers flush with finished surface in pavements. Set tops 3 inches above finish surface elsewhere, unless otherwise indicated.
- G. Install piping and oil storage tanks according to Section 231113 "Facility Fuel-Oil Piping."

3.3 CONNECTIONS

- A. Piping installation requirements are specified in Section 221316 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Make piping connections between interceptors and piping systems.

3.4 IDENTIFICATION

- A. Identification materials and installation are specified in Section 312000 "Earth Moving." Arrange for installation of green warning tapes directly over piping and at outside edges of underground interceptors.
 - 1. Use warning tapes or detectable warning tape over ferrous piping.
 - 2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

END OF SECTION 221323

SECTION 221513

GENERAL-SERVICE COMPRESSED-AIR PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes piping and related specialties for general-service compressed-air systems operating at 150 psig (1035 kPa) or less.
- B. See Section 221519 "General-Service Packaged Air Compressors and Receivers" for general-service air compressors and accessories.

1.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Compressed-air piping and support and installation shall withstand effects of seismic events determined according to SEI/ASCE 7, "Minimum Design Loads for Buildings and Other Structures."

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Pressure regulators. Include rated capacities and operating characteristics.
 - 2. Automatic drain valves.
 - 3. Filters. Include rated capacities and operating characteristics.
 - 4. Lubricators. Include rated capacities and operating characteristics.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for low-pressure compressed-air piping.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B, black with ends threaded according to ASME B1.20.1.
 - 1. Steel Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized seamless steel pipe. Include ends matching joining method.
 - 2. Malleable-Iron Fittings: ASME B16.3, Class 150 or 300, threaded.
 - 3. Malleable-Iron Unions: ASME B16.39, Class 150 or 300, threaded.
 - 4. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel, threaded.
 - 5. Wrought-Steel Butt-Welding Fittings: ASME B16.9, Schedule 40.
 - 6. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel.
- B. Copper Tube: **ASTM B 88, Type K or L (ASTM B 88M, Type A or B)** seamless, drawn-temper, water tube.
 - 1. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type or MSS SP-73, wrought copper with dimensions for brazed joints.
 - 2. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150 or 300.
 - 3. Copper Unions: ASME B16.22 or MSS SP-123.
- C. Transition Couplings for Metal Piping: Metal coupling or other manufactured fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- D. PVC Pipe: ASTM D 1785, Schedule 40.
 - 1. PVC Fittings: ASTM D 2466, Schedule 40, socket type.

2.2 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for compressed-air piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, full-face, asbestos free, **1/8-inch (3.2-mm)** maximum thickness.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated.
- E. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer complying with ASTM F 656.

2.3 VALVES

- A. Metal Ball, Butterfly, Check, and Gate Valves: Comply with requirements in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."

2.4 DIELECTRIC FITTINGS

- A. General Requirements for Dielectric Fittings: Combination fitting of copper alloy and ferrous materials with insulating material; suitable for system fluid, pressure, and temperature. Include threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Dielectric Unions: Factory-fabricated union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).

2.5 FLEXIBLE PIPE CONNECTORS

- A. Bronze-Hose Flexible Pipe Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 - 1. Working-Pressure Rating: 200 psig (1380 kPa) minimum.
 - 2. End Connections, NPS 2 (DN 50) and Smaller: Threaded copper pipe or plain-end copper tube.
 - 3. End Connections, NPS 2-1/2 (DN 65) and Larger: Flanged copper alloy.
- B. Stainless-Steel-Hose Flexible Pipe Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
 - 1. Working-Pressure Rating: 200 psig (1380 kPa) minimum.
 - 2. End Connections, NPS 2 (DN 50) and Smaller: Threaded steel pipe nipple.
 - 3. End Connections, NPS 2-1/2 (DN 65) and Larger: Flanged steel nipple.

2.6 SPECIALTIES

- A. Safety Valves: ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," construction; National Board certified, labeled, and factory sealed; constructed of bronze body with poppet-type safety valve for compressed-air service.
 - 1. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.
- B. Air-Main Pressure Regulators: Bronze body, pilot-operated direct acting, spring-loaded manual pressure-setting adjustment, and rated for 250-psig (1725-kPa) inlet pressure, unless otherwise indicated.
- C. Air-Line Pressure Regulators: Diaphragm or pilot operated, bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 200-psig (1380-kPa) minimum inlet pressure, unless otherwise indicated.

- D. Automatic Drain Valves: Stainless-steel body and internal parts, rated for 200-psig (1380-kPa) minimum working pressure, capable of automatic discharge of collected condensate. Include mounting bracket if wall mounting is indicated.
- E. Coalescing Filters: Coalescing type with activated carbon capable of removing water and oil aerosols; with color-change dye to indicate when carbon is saturated and warning light to indicate when selected maximum pressure drop has been exceeded. Include mounting bracket if wall mounting is indicated.
- F. Mechanical Filters: Two-stage, mechanical-separation-type, air-line filters. Equip with deflector plates, resin-impregnated-ribbon-type filters with edge filtration, and drain cock. Include mounting bracket if wall mounting is indicated.

2.7 QUICK COUPLINGS

- A. General Requirements for Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.
- B. Automatic-Shutoff Quick Couplings: Straight-through brass body with O-ring or gasket seal and stainless-steel or nickel-plated-steel operating parts.
 - 1. Socket End: With one-way valve and threaded inlet for connection to piping or threaded hose fitting.
 - 2. Plug End: Flow-sensor-bleeder, check-valve Straight-through type with barbed outlet for attaching hose.
- C. Valveless Quick Couplings: Straight-through brass body with stainless-steel or nickel-plated-steel operating parts.
 - 1. Socket End: With O-ring or gasket seal, without valve, and with barbed inlet for attaching hose.
 - 2. Plug End: With barbed outlet for attaching hose.

2.8 HOSE ASSEMBLIES

- A. Description: Compatible hose, clamps, couplings, and splicers suitable for compressed-air service, of nominal diameter indicated, and rated for 300-psig (2070-kPa) minimum working pressure, unless otherwise indicated.
 - 1. Hose: Reinforced double-wire-braid, CR-covered hose for compressed-air service.
 - 2. Hose Clamps: Stainless-steel clamps or bands.
 - 3. Hose Couplings: Two-piece, straight-through, threaded brass or stainless-steel O-ring or gasket-seal swivel coupling with barbed ends for connecting two sections of hose.
 - 4. Hose Splicers: One-piece, straight-through brass or stainless-steel fitting with barbed ends for connecting two sections of hose.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Compressed-Air Piping between Air Compressors and Receivers: Use one of the following piping materials for each size range:
 - 1. **NPS 2 (DN 50)** and Smaller: **Type K or L (Type A or B)**, copper tube; wrought-copper fittings; and brazed joints.

3.2 VALVE APPLICATIONS

- A. Comply with requirements in "Valve Applications" Article in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."
- B. Equipment Isolation Valves: Safety-exhaust, copper-alloy ball valve with exhaust vent and pressure rating at least as great as piping system operating pressure.

3.3 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping concealed from view and protected from physical contact by building occupants, unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and to coordinate with other services occupying that space.
- E. Install piping adjacent to equipment and machines to allow service and maintenance.
- F. Install air and drain piping with 1 percent slope downward in direction of flow.
- G. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating, unless otherwise indicated.
- H. Equipment and Specialty Flanged Connections:
 - 1. Use steel companion flange with gasket for connection to steel pipe.
 - 2. Use cast-copper-alloy companion flange with gasket and brazed or soldered joint for connection to copper tube. Do not use soldered joints for connection to air compressors or to equipment or machines producing shock or vibration.
- I. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.

- J. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver. Comply with requirements in Section 220519 "Meters and Gages for Plumbing Piping."
- K. Install piping to permit valve servicing.
- L. Install piping free of sags and bends.
- M. Install fittings for changes in direction and branch connections.
- N. Install seismic restraints on piping. Seismic-restraint devices are specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- O. Install unions, adjacent to each valve and at final connection to each piece of equipment and machine.
- P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from pipe and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Apply appropriate tape or thread compound to external pipe threads.
- D. Brazed Joints for Copper Tubing: Join according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- E. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Join according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Flanged Joints: Use asbestos-free, nonmetallic gasket suitable for compressed air. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.
- G. Solvent-Cemented Joints for PVC Piping: Clean and dry joining surfaces. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer and join according to ASME B31.9 for solvent-cemented joints and to ASTM D 2672.
- H. Dissimilar Metal Piping Material Joints: Use dielectric fittings.

3.5 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."
- B. Install shutoff valves and unions or flanged joints at compressed-air piping to air compressors.
- C. Install shutoff valve at inlet to each automatic drain valve, filter, lubricator, and pressure regulator.
- D. Install check valves to maintain correct direction of compressed-air flow to and from compressed-air piping specialties and equipment.

3.6 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric unions in piping at connections of dissimilar metal piping and tubing.

3.7 FLEXIBLE PIPE CONNECTOR INSTALLATION

- A. Install flexible pipe connectors in discharge piping and in inlet air piping from remote air-inlet filter of each air compressor.
- B. Install bronze-hose flexible pipe connectors in copper compressed-air tubing.
- C. Install stainless-steel-hose flexible pipe connectors in steel compressed-air piping.

3.8 SPECIALTY INSTALLATION

- A. Install safety valves on receivers in quantity and size to relieve at least the capacity of connected air compressors.
- B. Install air-main pressure regulators in compressed-air piping at or near air compressors.
- C. Install air-line pressure regulators in branch piping to equipment.
- D. Install automatic drain valves on aftercoolers, receivers, and dryers. Discharge condensate onto nearest floor drain.
- E. Install mechanical filters in compressed-air piping at or near air compressors and downstream from coalescing filters.
- F. Install quick couplings at piping terminals for hose connections.
- G. Install hose assemblies at hose connections.

3.9 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

- B. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.
- C. Vertical Piping: MSS Type 8 or 42, clamps.
- D. Individual, Straight, Horizontal Piping Runs:
 - 1. 100 Feet (30 m) or Less: MSS Type 1, adjustable, steel clevis hangers.
 - 2. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
- E. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
- F. Base of Vertical Piping: MSS Type 52, spring hangers.
- G. Support horizontal piping within 12 inches (300 mm) of each fitting and coupling.
- H. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
- I. Install hangers for Schedule 40, steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1/4 to NPS 1/2 (DN 8 to DN 15): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 3/4 to NPS 1-1/4 (DN 20 to DN 32): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 1-1/2 (DN 40): 12 feet (3.7 m) with 3/8-inch (10-mm) rod.
 - 4. NPS 2 (DN 50): 13 feet (4 m) with 3/8-inch (10-mm) rod.
- J. Install supports for vertical, Schedule 40, steel piping every 15 feet (4.6 m).
- K. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1/4 (DN 8): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 3/8 and NPS 1/2 (DN 10 and DN 15): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 3/4 (DN 20): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 - 4. NPS 1 (DN 25): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 - 5. NPS 1-1/4 (DN 32): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 - 6. NPS 1-1/2 (DN 40): 10 feet (3 m) with 3/8-inch (10-mm) rod.
 - 7. NPS 2 (DN 50): 11 feet (3.4 m) with 3/8-inch (10-mm) rod.
- L. Install supports for vertical copper tubing every 10 feet (3 m).

3.10 LABELING AND IDENTIFICATION

- A. Install identifying labels and devices for general-service compressed-air piping, valves, and specialties. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment."

3.11 FIELD QUALITY CONTROL

A. Perform field tests and inspections.

B. Tests and Inspections:

1. Piping Leak Tests: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of **50 psig (345 kPa)** above system operating pressure, but not less than **150 psig (1035 kPa)**. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
2. Repair leaks and retest until no leaks exist.
3. Inspect filters lubricators and pressure regulators for proper operation.

END OF SECTION 221513

SECTION 221519

GENERAL-SERVICE PACKAGED AIR COMPRESSORS AND RECEIVERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Lubricated, reciprocating air compressors.
 - 2. Oil-flooded, rotary-screw air compressors.
 - 3. Oil-sealed, rotary, sliding-vane air compressors.
 - 4. Inlet-air filters.
 - 5. Air-cooled, compressed-air aftercoolers.
 - 6. Refrigerant compressed-air dryers.

1.2 DEFINITIONS

- A. Actual Air: Air delivered from air compressors. Flow rate is delivered compressed air measured in **acfm** (actual L/s).
- B. Standard Air: Free air at **68 deg F (20 deg C)** and **1 atmosphere (29.92 in. Hg)** before compression or expansion and measured in **scfm** (standard L/s).

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- 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. ASME Compliance: Fabricate and label receivers to comply with ASME Boiler and Pressure Vessel Code.

2.2 GENERAL REQUIREMENTS FOR PACKAGED AIR COMPRESSORS AND RECEIVERS

- A. General Description: Factory-assembled, -wired, -piped, and -tested; electric-motor-driven; air-cooled; continuous-duty air compressors and receivers that deliver air of quality equal to intake air.
- B. Control Panels: Automatic control station with load control and protection functions. Comply with NEMA ICS 2 and UL 508.
 - 1. Enclosure: NEMA ICS 6, Type 12 control panel unless otherwise indicated.
 - 2. Motor Controllers: Full-voltage, combination magnetic type with under-voltage release feature and motor-circuit-protector-type disconnecting means and short-circuit protective device.
 - 3. Control Voltage: 120-V ac or less, using integral control power transformer.
 - 4. Motor Overload Protection: Overload relay in each phase.
 - 5. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.
 - 6. Automatic control switches to alternate lead-lag compressors for duplex air compressors.
 - 7. Instrumentation: Include discharge-air pressure gage, air-filter maintenance indicator, hour meter, compressor discharge-air and coolant temperature gages, and control transformer.
 - 8. Alarm Signal Device: For connection to alarm system to indicate when backup air compressor is operating.
- C. Receivers: Steel tank constructed according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 - 1. Pressure Rating: At least as high as highest discharge pressure of connected compressors, and bearing appropriate code symbols.
 - 2. Interior Finish: Corrosion-resistant coating.
 - 3. Accessories: Include safety valve, pressure gage, drain, and pressure-reducing valve.
- D. Mounting Frame: Fabricate mounting and attachment to pressure vessel with reinforcement strong enough to resist packaged equipment movement during a seismic event when base is anchored to building structure.

2.3 LUBRICATED, RECIPROCATING AIR COMPRESSORS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - 1. [Atlas Copco](#).
 - 2. [CompAir, Ltd.](#)
 - 3. [General Air Products, Inc.](#)
 - 4. [Ingersoll-Rand](#).
 - 5. [Kaeser Compressors, Inc.](#)
 - 6. [Powerex, Inc.](#)
- B. Compressor(s): Lubricated, reciprocating-piston type with lubricated compression chamber and crankcase.
 - 1. Submerged gear-type oil pump.

2. Oil filter.
3. Combined high discharge-air temperature and low lubrication-oil pressure switch.
4. Belt guard totally enclosing pulleys and belts.

C. Capacities and Characteristics:

1. Air Compressor(s): Two stage.
 - a. Intercooler between stages of two-stage units.
2. Discharge-Air Pressure: 175 psig (1200 kPa).
3. Mounting: Tank mounted.
4. Motor (Each Air Compressor):
 - a. Horsepower: 10
5. Receiver: ASME construction steel tank.
 - a. Arrangement: Vertical.
 - b. Capacity: 100.
 - c. Interior Finish: Epoxy coating.
 - d. Pressure Rating: 200 psig (1380 kPa) minimum.
 - e. Drain: Automatic valve.

2.4 OIL-FLOODED, ROTARY-SCREW AIR COMPRESSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. [Atlas Copco](#).
2. [CompAir, Ltd.](#)
3. [General Air Products, Inc.](#)
4. [Ingersoll-Rand](#).
5. [Kaeser Compressors, Inc.](#)
6. [Powerex, Inc.](#)

B. Compressor(s): Oil-flooded, rotary-screw type with lubricated helical screws and lubricated gear box.

1. Coupling: Non-lubricated, flexible type.
2. Cooling/Lubrication System: Unit-mounted, air-cooled exchanger package pre-piped to unit; with air pressure circulation system with coolant stop valve, full-flow coolant filter, and thermal bypass valve.
3. Air Filter: Dry type, with maintenance indicator and cleanable, replaceable filter element.
4. Air/Coolant Receiver and Separation System: 150-psig- (1035-kPa-) rated steel tank with ASME safety valve, coolant-level gage, multistage air-coolant separator element, minimum pressure valve, blowdown valve, discharge check valve, coolant stop valve, full-flow coolant filter, and thermal bypass valve.
5. Capacity Control: Capacity modulation between zero and 100 percent air delivery, with operating pressures between 50 and 100 psig (345 and 690 kPa). Include necessary control to hold constant pressure. When air demand is zero, unload compressor by using pressure switch and blowdown valve.

- C. Capacities and Characteristics:
- D. Capacities and Characteristics:
 - 1. Air Compressor(s): Two stage.
 - a. Intercooler between stages of two-stage units.
 - 2. Discharge-Air Pressure: 175 psig (1200 kPa).
 - 3. Mounting: Tank mounted.
 - 4. Receiver: ASME construction steel tank.
 - a. Arrangement: Vertical.
 - b. Capacity: 100.
 - c. Interior Finish: Epoxy coating.
 - d. Pressure Rating: 200 psig (1380 kPa) minimum.
 - e. Drain: Automatic valve.
 - 5. Enclosure: Steel with sound-attenuating material lining.

2.5 OIL-SEALED, ROTARY, SLIDING-VANE AIR COMPRESSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. [Atlas Copco.](#)
 - 2. [CompAir, Ltd.](#)
 - 3. [General Air Products, Inc.](#)
 - 4. [Ingersoll-Rand.](#)
 - 5. [Kaeser Compressors, Inc.](#)
 - 6. [Powerex, Inc.](#)
- B. Compressor(s): Non-pulsating, rotary, sliding-vane type with oil-sealed sliding vanes.
 - 1. Cleanable inlet screens.
 - 2. Outlet silencers and oil-mist separators on discharge connections.
- C. Capacities and Characteristics:
 - 1. Air Compressor(s): Two stage.
 - a. Intercooler between stages of two-stage units.
 - 2. Discharge-Air Pressure: 175 psig (1200 kPa).
 - 3. Mounting: Tank mounted.
 - 4. Motor (Each Air Compressor):
 - 5. Receiver: ASME construction steel tank.
 - a. Arrangement: Vertical.
 - b. Capacity: 100.
 - c. Interior Finish: Epoxy coating.
 - d. Pressure Rating: 200 psig (1380 kPa) minimum.

- e. Drain: Automatic valve.

2.6 INLET-AIR FILTERS

- A. Description: Combination inlet-air filter-silencer, suitable for remote installation, for each air compressor.
 - 1. Construction: Weatherproof housing for replaceable, dry-type filter element, with silencer tubes or other method of sound reduction.
 - 2. Capacity: Match capacity of air compressor, with filter having collection efficiency of 99 percent retention of particles larger than 10 micrometers.
- B. Description: Combination inlet-air filter-silencer, suitable for remote installation, for multiple air compressors.
 - 1. Construction: Weatherproof housing for replaceable, dry-type filter element, with silencer tubes or other method of sound reduction.
 - 2. Capacity: Match total capacity of connected air compressors, with filter having collection efficiency of 99 percent retention of particles larger than 10 micrometers.

2.7 AIR-COOLED, COMPRESSED-AIR AFTERCOOLERS

- A. Description: Electric-motor-driven, fan-operation, finned-tube unit; rated at 250 psig (1725 kPa) and leak tested at 350-psig (2415-kPa) minimum air pressure; in capacities indicated. Size units to cool compressed air in compressor-rated capacities to 10 deg F (6 deg C) above summertime maximum ambient temperature. Include moisture separator and automatic drain.

2.8 REFRIGERANT COMPRESSED-AIR DRYERS

- A. Description: Non-cycling, air-cooled, electric-motor-driven unit with steel enclosure and capability to deliver 35 deg F (2 deg C), 100-psig (690-kPa) air at dew point. Include automatic ejection of condensate from airstream, step-down transformers, disconnect switches, inlet and outlet pressure gages, thermometers, automatic controls, and filters.

2.9 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."
 - 1. Enclosure: Dust-ignition-proof machine.
 - 2. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load does not require motor to operate in service factor range above 1.0.
- B. .

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Equipment Mounting:

1. Install air compressors and aftercoolers and air dryers , aftercoolers, and air dryers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete." Section 033053 "Miscellaneous Cast-in-Place Concrete."
2. Install water-cooled, compressed-air aftercoolers and desiccant compressed-air dryers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete." Section 033053 "Miscellaneous Cast-in-Place Concrete."
3. Comply with requirements for vibration isolation and seismic control devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment"
4. Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."

B. Install compressed-air equipment anchored to substrate.

C. Arrange equipment so controls and devices are accessible for servicing.

D. Maintain manufacturer's recommended clearances for service and maintenance.

E. Install the following devices on compressed-air equipment:

1. Thermometer, Pressure Gage, and Safety Valve: Install on each compressed-air receiver.
2. Pressure Regulators: Install downstream from air compressors and dryers.
3. Automatic Drain Valves: Install on aftercoolers, receivers, and dryers. Discharge condensate over nearest floor drain.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 221513 "General-Service Compressed-Air Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to machine, allow space for service and maintenance.

3.3 IDENTIFICATION

A. Identify general-service air compressors and components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air compressors, aftercoolers, and air dryers.

END OF SECTION 221519

SECTION 223400

FUEL-FIRED, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Commercial, atmospheric, gas-fired, storage, domestic-water heaters.
2. Commercial, power-vent, gas-fired, storage, domestic-water heaters.
3. Commercial, Gas-Fired, High-Efficiency, Storage, Domestic-Water Heaters:
4. Domestic-water heater accessories.

1.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.3 ACTION SUBMITTALS

A. Product Data: For each type and size of domestic-water heater indicated.

B. LEED Submittals:

1. Product Data for Prerequisite EA 2: Documentation indicating that units comply with applicable requirements in ASHRAE/IESNA 90.1, Section 7, "Service Water Heating."

C. Shop Drawings:

1. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For fuel-fired, domestic-water heaters, accessories, and components, from manufacturer.

B. Product certificates.

C. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

D. Source quality-control reports.

- E. Field quality-control reports.
- F. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE/IESNA Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IESNA 90.1.
- C. ASME Compliance:
 - 1. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 - 2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube, domestic-water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects."

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Periods: From date of Substantial Completion.
 - a. Commercial, Gas-Fired, Storage, Domestic-Water Heaters:
 - 1) Storage Tank: Five years.
 - 2) Controls and Other Components: Two year(s).
 - b. Compression Tanks: Five years.

PART 2 - PRODUCTS

2.1 COMMERCIAL, GAS-FIRED, STORAGE, DOMESTIC-WATER HEATERS

- A. Commercial, Atmospheric, Gas-Fired, Storage, Domestic-Water Heaters:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [Bradford White Corporation.](#)
 - b. [Lochinvar, LLC.](#)
 - c. [Rheem Manufacturing Company.](#)
 - d. [Smith, A. O. Corporation.](#)
 - e. [State Industries.](#)
 - f. PVI
 - g. HTP

2. Standard: ANSI Z21.10.3/CSA 4.3.
3. Storage-Tank Construction: ASME-code steel with 150-psig working-pressure rating.
 - a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
 - 1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
 - 2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
 - b. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Lining: Glass complying with NSF 61 Annex G barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.

4. Factory-Installed Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
 - e. Jacket: Steel with enameled finish.
 - f. Burner: For use with atmospheric, gas-fired, domestic-water heaters and natural-gas fuel.
 - g. Automatic Ignition: ANSI Z21.20/CSA C22.2 No. 199, electric, automatic, gas-ignition system.
 - h. Temperature Control: Adjustable thermostat.
 - i. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
 - j. Combination Temperature-and-Pressure Relief Valves: ANSI Z21.22/CSA 4.4-M. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

B. Commercial, Power-Vent, Gas-Fired, Storage, Domestic-Water Heaters:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [Bradford White Corporation.](#)
 - b. [Lochinvar, LLC.](#)

- c. [Rheem Manufacturing Company](#).
 - d. [Smith, A. O. Corporation](#).
 - e. [State Industries](#).
 - f. PVI
 - g. Bock Water Heaters
 - h. HTP
2. Standard: ANSI Z21.10.3/CSA 4.3.
 3. Storage-Tank Construction: ASME-code steel with 150-psig (1035-kPa) working-pressure rating.
 - a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
 - 1) NPS 2 (DN 50) and Smaller: Threaded ends according to ASME B1.20.1.
 - 2) NPS 2-1/2 (DN 65) and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
 - b. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Lining: Glass complying with NSF 61 Annex G barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.
 4. Factory-Installed Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
 - e. Jacket: Steel with enameled finish.
 - f. Burner: For use with power-vent, gas-fired, domestic-water heaters and natural-gas fuel.
 - g. Automatic Ignition: ANSI Z21.20/CSA C22.2 No. 199, electric, automatic, gas-ignition system.
 - h. Temperature Control: Adjustable thermostat.
 - i. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
 - j. Combination Temperature-and-Pressure Relief Valves: ANSI Z21.22/CSA 4.4-M. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
 5. Special Requirements: NSF 5 construction.
 6. Power-Vent System: Exhaust fan, interlocked with burner.
- C. Commercial, Gas-Fired, High-Efficiency, Storage, Domestic-Water Heaters:
1. [Manufacturers](#): Subject to compliance with requirements, provide products by one of the following:
 - a. [Bradford White Corporation](#).

- b. [Lochinvar, LLC.](#)
 - c. [Rheem Manufacturing Company.](#)
 - d. [Smith, A. O. Corporation.](#)
 - e. [State Industries.](#)
 - f. PVI
 - g. HTP
- 2.
3. Standard: ANSI Z21.10.3/CSA 4.3.
4. Description: Manufacturer's proprietary design to provide at least 95 percent combustion efficiency at optimum operating conditions.
5. Storage-Tank Construction: ASME-code steel with 150-psig (1035-kPa) minimum working-pressure rating.
- a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
 - 1) NPS 2 (DN 50) and Smaller: Threaded ends according to ASME B1.20.1.
 - 2) NPS 2-1/2 (DN 65) and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
 - b. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Lining: Glass complying with NSF 61 Annex G barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.
6. Factory-Installed Storage-Tank Appurtenances:
- a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
 - e. Jacket: Steel with enameled finish.
 - f. Burner or Heat Exchanger: Comply with UL 795 or approved testing agency requirements for gas-fired, high-efficiency, domestic-water heaters and natural-gas fuel.
 - g. Temperature Control: Adjustable thermostat.
 - h. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
 - i. Combination Temperature-and-Pressure Relief Valves: ANSI Z21.22/CSA 4.4-M. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
7. Electrical Characteristics:
- a. Volts: 120.
 - b. Phase: Single.
 - c. Hertz: 60.
 - d. Maximum Overcurrent Protection: 15 A
8. Minimum Vent Diameter: 3"

2.2 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Compression Tanks:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [AMTROL, Inc.](#)
 - b. [Smith, A. O. Corporation.](#)
 - c. [State Industries.](#)
 - d. [Taco, Inc.](#)
2. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air pre-charge to minimum system-operating pressure at tank.
3. Construction:
 - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
 - b. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-Charging Valve: Factory installed.
4. Capacity and Characteristics:
 - a. Working-Pressure Rating: 100 psig.
 - b. Capacity Acceptable: 4 gal. minimum.

B. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.

C. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1.

D. Heat-Trap Fittings: ASHRAE 90.2.

E. Gas Shutoff Valves: ANSI Z21.15/CSA 9.1-M, manually operated. Furnish for installation in piping.

F. Gas Pressure Regulators: ANSI Z21.18/CSA 6.3, appliance type. Include 2-psig pressure rating as required to match gas supply.

G. Automatic Gas Valves: ANSI Z21.21/CSA 6.5, appliance, electrically operated, on-off automatic valve.

H. Combination Temperature-and-Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4-M.
2. Oil-Fired, Domestic-Water Heaters: ASME rated and stamped.

- I. Pressure Relief Valves: Include pressure setting less than domestic-water heater working-pressure rating.
 - 1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4-M.
 - 2. Oil-Fired, Domestic-Water Heaters: ASME rated and stamped.
- J. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4-M.
- K. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Provide dimension that will support bottom of domestic-water heater a minimum of 18 inches above the floor.
- L. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect assembled domestic-water heaters and storage tanks specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test domestic-water heaters and storage tanks to minimum of one and one-half times pressure rating before shipment.
- C. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and re-inspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Domestic-Water Heater Mounting: Install commercial domestic-water heaters on concrete base.
 - 1. Exception: Omit concrete bases for commercial domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
 - 2. Maintain manufacturer's recommended clearances.
 - 3. Arrange units so controls and devices that require servicing are accessible.
 - 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 7. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 8. Anchor domestic-water heaters to substrate.

- B. Install domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
 - 1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."
 - C. Install gas-fired, domestic-water heaters according to NFPA 54.
 - 1. Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.
 - 2. Install gas pressure regulators on gas supplies to gas-fired, domestic-water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
 - 3. Install automatic gas valves on gas supplies to gas-fired, domestic-water heaters if required for operation of safety control.
 - D. Install commercial domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
 - E. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
 - F. Install combination temperature-and-pressure relief valves in water piping for domestic-water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
 - G. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."
 - H. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."
 - I. Install piping-type heat traps on inlet and outlet piping of domestic-water heater storage tanks without integral or fitting-type heat traps.
 - J. Fill domestic-water heaters with water.
 - K. Charge domestic-water compression tanks with air.
- 3.2 CONNECTIONS
- A. Comply with requirements for domestic-water piping specified in Section 221116 "Domestic Water Piping."

- B. Comply with requirements for fuel-oil piping specified in Section 231113 "Facility Fuel-Oil Piping."
- C. Drawings indicate general arrangement of piping, fittings, and specialties.
- D. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and re-inspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.
- C. Prepare test and inspection reports.

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain commercial, gas-fired, storage, domestic-water heaters.

END OF SECTION 223400

SECTION 224213.13

COMMERCIAL WATER CLOSETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Water closets.
 - 2. Flushometer valves.
 - 3. Toilet seats.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 FLOOR-MOUNTED, BOTTOM-OUTLET WATER CLOSETS

- A. Water Closets: Floor mounted, bottom outlet, top spud.
 - 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [American Standard America.](#)
 - b. [Crane Plumbing, L.L.C.](#)
 - c. [Kohler Co.](#)
 - d. [TOTO USA, INC.](#)
 - e. [Zurn Industries, LLC.](#)
 - f. Sloan
 - 2. Bowl:
 - a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
 - b. Material: Vitreous china.
 - c. Type: Siphon jet.
 - d. Style: Flushometer valve.
 - e. Height: Standard

- f. Rim Contour: Elongated.
 - g. Water Consumption: 1.28 gal. per flush.
 - h. MaP Score: 1,000
 - i. Spud Size and Location: NPS 1-1/2; top.
 - j. Color: White.
- 3. Bowl-to-Drain Connecting Fitting: ASME A112.4.3.
 - 4. Coordinate "Toilet Seat" Subparagraph with "Toilet Seats" Article.

2.2 WALL-MOUNTED WATER CLOSETS

A. Water Closets: Wall mounted, top spud, accessible.

- 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [American Standard America.](#)
 - b. [Crane Plumbing, L.L.C.](#)
 - c. [Kohler Co.](#)
 - d. [TOTO USA, INC.](#)
 - e. [Zurn Industries, LLC.](#)
 - f. Sloan
- 2. Bowl:
 - a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
 - b. Material: Vitreous china.
 - c. Type: Siphon jet.
 - d. Style: Flushometer valve.
 - e. Height: Standard.
 - f. Rim Contour: Elongated.
 - g. Water Consumption: 1.28 gal. per flush.
 - h. MaP Score: 1,000
 - i. Spud Size and Location: NPS 1-1/2; top.
- 3. Support:
 - a. Standard: ASME A112.6.1M.
 - b. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture.

2.3 FLUSHOMETER VALVES

A. Lever-Handle, Diaphragm Flushometer Valves:

- 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [Sloan Valve Company.](#)
 - b. [Zurn Industries, LLC.](#)
- 2. Standard: ASSE 1037.

3. Minimum Pressure Rating: 125 psig.
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Consumption: 1.28 gal. per flush.
8. Minimum Inlet: NPS 1.
9. Minimum Outlet: NPS 1-1/4.

2.4 TOILET SEATS

A. Toilet Seats

1. Standard: IAPMO/ANSI Z124.5.
2. Material: Plastic.
3. Type: Commercial (Standard).
4. Shape: Elongated rim, open front.
5. Hinge Material: Non-corroding metal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.

B. Support Installation:

1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
2. Use carrier supports with waste-fitting assembly and seal.
3. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.

C. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
4. Install actuators in locations that are easy for people with disabilities to reach.

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.

3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

F. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.2 CONNECTIONS

- A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.3 ADJUSTING

- A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.

3.4 CLEANING AND PROTECTION

- A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed water closets and fittings.
- C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.13

SECTION 224213.16
COMMERCIAL URINALS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Urinals.
 - 2. Flushometer valves.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 WALL-HUNG URINALS

- A. Urinals: Wall hung, back outlet, washout, accessible.
 - 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard America.
 - b. Kohler Co.
 - c. Zurn Industries, LLC.
 - d. Sloan
 - 2. Fixture:
 - a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
 - b. Material: Vitreous china.
 - c. Type: Washout.
 - d. Strainer or Trapway: Manufacturer's standard strainer with integral trap.
 - e. Water Consumption: 0.125 GPF.
 - f. Spud Size and Location: NPS 3/4; top.
 - g. Outlet Size and Location: NPS 2; back.
 - h. Color: White.

3. Waste Fitting:
 - a. Standard: ASME A112.18.2/CSA B125.2 for coupling.
 - b. Size: NPS 2.
4. Support: ASME A112.6.1M, Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture. Include rectangular, steel uprights.

2.2 URINAL FLUSHOMETER VALVES

A. Lever-Handle, Diaphragm Flushometer Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Sloan Valve Company.
 - b. Zurn Industries, LLC.
2. Standard: ASSE 1037.
3. Minimum Pressure Rating: 125 psig.
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Style: Exposed.
8. Consumption: 0.125 gal. per flush.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before urinal installation.
- B. Examine walls and floors for suitable conditions where urinals will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Urinal Installation:

1. Install urinals level and plumb according to roughing-in drawings.
2. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.
3. Install wall-hung, bottom-outlet urinals with tubular waste piping attached to supports.
4. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC/ANSI A117.1.
5. Install trap-seal liquid in waterless urinals.

B. Support Installation:

1. Install supports, affixed to building substrate, for wall-hung urinals.
2. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
3. Use carriers without waste fitting for urinals with tubular waste piping.
4. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.

C. Flushometer-Valve Installation:

1. Install flushometer-valve water-supply fitting on each supply to each urinal.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.
4. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

D. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

E. Joint Sealing:

1. Seal joints between urinals and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to urinal color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

- A. Connect urinals with water supplies and soil, waste, and vent piping. Use size fittings required to match urinals.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to urinals, allow space for service and maintenance.

3.4 ADJUSTING

- A. Operate and adjust urinals and controls. Replace damaged and malfunctioning urinals, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

- A. Clean urinals and fittings with manufacturers' recommended cleaning methods and materials.

- B. Install protective covering for installed urinals and fittings.
- C. Do not allow use of urinals for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.16

SECTION 224216.13

COMMERCIAL LAVATORIES & SINKS

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. Service sinks.
 - 2. Lavatories
 - 3. Sinks
 - 4. Sink faucets.
 - 5. Laminar-flow, faucet-spout outlets.
 - 6. Supply fittings.
 - 7. Waste fittings.
- B. Related Requirements:
 - 1. Section 224100 "Residential Plumbing Fixtures" for residential sinks.

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 for sinks.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sinks to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
 - 2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 SERVICE SINKS

- A. Service Sinks: Enameled, cast iron, floor mounted.
 - a. [American Standard America.](#)
 - b. [Kohler Co.](#)
 - c. [Zurn Industries, LLC.](#)
- 2. Fixture:
 - a. Standard: ASME A112.19.1/CSA B45.2.
 - b. Style: With front apron and raised back.
 - c. Nominal Size: 28 by 28 inches (710 by 710 mm).
 - d. Color: White.
 - e. Drain: Grid with NPS 3 (DN 80) outlet.
 - f. Rim Guard: Coated wire.

2.2 LAVATORIES

- A. Lavatory: Oval, under-mount, vitreous China.
 - 1. Manufacturers: Shall be one of the following:
 - a. [American Standard America.](#)
 - b. [Bradley Corporation.](#)
 - c. [Chicago Faucets; Geberit Company.](#)
 - d. [Delta Faucet Company.](#)
 - e. [Eljer, Inc.](#)
 - f. [Elkay Manufacturing Co.](#)
 - g. [GROHE America, Inc.](#)
 - h. [Just Manufacturing.](#)
 - i. [Kohler Co.](#)
 - j. [Moen Incorporated.](#)
 - k. [Price Pfister, Inc.](#)
 - l. [Speakman Company.](#)
 - m. [T & S Brass and Bronze Works, Inc.](#)
 - n. [Zurn Industries, LLC.](#)
 - o. Sloan

2. Fixture:
 - a. Standard: ASME A112.19.1/CSA B45.2.
 - b. Type: For undercounter mounting.
 - c. Nominal Size: Oval, 19 by 16 inches.
 - d. Faucet-Hole Punching: No holes.
 - e. Faucet-Hole Location: On countertop.
 - f. Color: White.
 - g. Mounting Materials: Sealant and undercounter mounting kit.

2.3 SINKS

- A. Sinks S-1: Stainless steel, dual mount. Elkay ECTSRS or equal by below manufacturers.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. [Advance Tabco.](#)
- b. [Elkay Manufacturing Co.](#)
- c. [Just Manufacturing.](#)

2. Fixture:

- a. Standard: ASME A112.19.3/CSA B45.4.
- b. Type: Ledge back.
- c. Number of Compartments: One
- d. Overall Dimensions: 33x22
- e. Material: 304, 18-8 Stainless Steel, 18 Gauge
- f. Holes: Single
- g. Mounting Type: Undermount

- B. Sinks S-2: Stainless steel two bowl farmhouse style Elkay ELUHFS or equal by below manufacturers.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. [Advance Tabco.](#)
- b. [Elkay Manufacturing Co.](#)
- c. [Just Manufacturing.](#)
- d. Sloan

2. Fixture:

- a. Standard: ASME A112.19.3/CSA B45.4.
- b. Type: Farmhouse
- c. Number of Compartments: Two
- d. Overall Dimensions: 28x16
- e. Material: Stainless
- f. Holes: Single.
- g. Mounting Type: Under Counter/Farmhouse

- C. Sinks S-3: Stainless steel, dual mount. Elkay ECTSRS or equal by below manufacturers.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [Advance Tabco.](#)
 - b. [Elkay Manufacturing Co.](#)
 - c. [Just Manufacturing.](#)

2. Fixture:
 - a. Standard: ASME A112.19.3/CSA B45.4.
 - b. Type: Ledge back.
 - c. Number of Compartments: One
 - d. Overall Dimensions: 33x22
 - e. Material: 304, 18-8 Stainless Steel, 18 Gauge
 - f. Holes: Single
 - g. Mounting Type: Undermount

2.4 SINK FAUCETS

A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for faucet-spout materials that will be in contact with potable water.

B. Sink Faucets for S-1, S-2, & S-3: Manual type, single lever, ADA compliant

1. Commercial, Polished Chrome. Elkay LKAV2061 or equal by below manufacturers.

a. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

- 1) [American Standard America.](#)
- 2) [Bradley Corporation.](#)
- 3) [Chicago Faucets; Geberit Company.](#)
- 4) [Delta Faucet Company.](#)
- 5) [Eljer, Inc.](#)
- 6) [Elkay Manufacturing Co.](#)
- 7) [GROHE America, Inc.](#)
- 8) [Just Manufacturing.](#)
- 9) [Kohler Co.](#)
- 10) [Moen Incorporated.](#)
- 11) [Price Pfister, Inc.](#)
- 12) Sloan
- 13) [Speakman Company.](#)
- 14) [T & S Brass and Bronze Works, Inc.](#)
- 15) [Zurn Industries, LLC.](#)

2. Standard: ASME A112.18.1/CSA B125.1.

3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole-punching; coordinate outlet with spout and sink receptor.

4. Body Type: Single hole.

5. Body Material: General-duty, brushed nickel

6. Finish: Brushed

7. Maximum Flow Rate: 1.5 gpm.

8. Handle(s): Lever.

9. Mounting Type: Deck, exposed.
 10. Spout Type: Swinging with pull down head sprayer.
- C. Sink Faucets for L-1: Automatic-type, battery-powered, electronic-sensor-operated, mixing, solid-brass valve.
1. Commercial, Polished Chrome. Moen SF-2350 or equal by below manufacturers.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) [American Standard America.](#)
 - 2) [Bradley Corporation.](#)
 - 3) [Chicago Faucets; Geberit Company.](#)
 - 4) [Delta Faucet Company.](#)
 - 5) [Eljer, Inc.](#)
 - 6) [Elkay Manufacturing Co.](#)
 - 7) [GROHE America, Inc.](#)
 - 8) [Just Manufacturing.](#)
 - 9) [Kohler Co.](#)
 - 10) [Moen Incorporated.](#)
 - 11) [Price Pfister, Inc.](#)
 - 12) Sloan
 - 13) [Speakman Company.](#)
 - 14) [T & S Brass and Bronze Works, Inc.](#)
 - 15) [Zurn Industries, LLC.](#)
 2. Standard: ASME A112.18.1/CSA B125.1.
 3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
 4. Body Type: Single hole.
 5. Body Material: General-duty, chrome plated
 6. Finish: Brushed
 7. Maximum Flow Rate: 0.5 gpm.
 8. Handle(s): Automatic, battery powered, electronic sensor operated
 9. Mounting Type: Deck, exposed.
 10. Spout Type: Stationary type.

2.5 LAMINAR-FLOW, FAUCET-SPOUT OUTLETS

- A. NSF Standard: Comply with NSF/ANSI 61 Annex 61, "Drinking Water System Components - Health Effects," for faucet-spout-outlet materials that will be in contact with potable water.
- B. Description: Chrome-plated brass, faucet-spout outlet that produces non-aerating, laminar stream. Include external or internal thread that mates with faucet outlet for attachment to faucets where indicated and flow-rate range that includes flow of faucet.

2.6 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.
- D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Loose key.

2.7 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.
- C. Trap:
 - 1. Size: NPS 1-1/2.
 - 2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated brass or steel wall flange.
 - 3. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless-steel tube to wall; and stainless-steel wall flange.

2.8 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Non-shrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.
- B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install sinks level and plumb according to roughing-in drawings.

- B. Install supports, affixed to building substrate, for wall-hung sinks.
- C. Install accessible wall-mounted sinks at handicapped/elderly mounting height according to ICC/ANSI A117.1.
- D. Set floor-mounted sinks in leveling bed of cement grout.
- E. Install water-supply piping with stop on each supply to each sink faucet.
 - 1. Exception: Use ball or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."
 - 2. Install stops in locations where they can be easily reached for operation.
- F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- G. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- H. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 CONNECTIONS

- A. Connect sinks with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

- A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

- A. After completing installation of sinks, inspect and repair damaged finishes.
- B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed sinks and fittings.

D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.16

SECTION 224223

COMMERCIAL SHOWERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Individual showers.
2. Shower faucets.
3. Grout.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 INDIVIDUAL SHOWERS

A. Individual FRP Showers

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [Aqua Glass Corporation.](#)
 - b. [Praxis Industries, LLC.](#)
 - c. [Sterling.](#)
 - d. [Swan Corporation \(The\).](#)
2. General: FRP, accessible, shower enclosure with faucet and receptor and appurtenances.
3. Standard: ANSI Z124.1.2.
4. Type: One-piece unit without top.
5. Style: Standard residential.
6. Color: By Architect.
7. Bathing Surface: Slip resistant according to ASTM F 462.

8. Outlet: Drain with **NPS 2 (DN 50)** outlet.

B. Individual PMMA Showers:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [Acryline USA, Inc.](#)
 - b. [Aqua Bath Company, Inc.](#)
 - c. [Aqua Glass Corporation.](#)
 - d. [Aquatic Industries, Inc.](#)
 - e. [Clarion Bathware.](#)
 - f. [Crane Plumbing, L.L.C.](#)
 - g. [Jacuzzi Inc.](#)
 - h. [Kohler Co.](#)
 - i. [Praxis Industries, LLC.](#)
2. General: PMMA shower enclosure with faucet and receptor and appurtenances.
3. Standard: ANSI Z124.1.2.
4. Type: One-piece unit without top.
5. Style: Standard residential.
6. Color By Architect
7. Bathing Surface: Slip resistant according to ASTM F 462.
8. Outlet: Drain with **NPS 2 (DN 50)** outlet.

2.2 SHOWER FAUCETS

A. NSF Standard: Comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects," for shower materials that will be in contact with potable water.

B. Shower Faucets:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [American Standard America.](#)
 - b. [Chicago Faucets; Geberit Company.](#)
 - c. [FNW; Ferguson Enterprises, Inc.](#)
 - d. [Kohler Co.](#)
 - e. [Lawler Manufacturing Company, Inc.](#)
 - f. [Leonard Valve Company.](#)
 - g. [Moen Incorporated.](#)
 - h. [Powers.](#)
 - i. [Sloan Valve Company.](#)
 - j. [Speakman Company.](#)
 - k. [Zurn Industries, LLC.](#)
2. Description: Single-handle, pressure-balance mixing valve with hot- and cold-water indicators; check stops; and shower head.

3. Faucet:
 - a. Standards: ASME A112.18.1/CSA B125.1 and ASSE 1016.
 - b. Body Material: Solid brass.
 - c. Finish: Polished chrome plate.
 - d. Shower-Arm, Flow-Control Fitting: 2.0 gpm (7.6 L/min.).
 - e. EPA WaterSense: Required.
 - f. Mounting: Exposed.
 - g. Operation: Single-handle, push-pull or twist or rotate control.
 - h. Anti-scald Device: Integral with mixing valve.
 - i. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
4. Supply Connections: NPS 1/2 (DN 15).
5. Shower Head:
 - a. Standard: ASME A112.18.1/CSA B125.1.
 - b. Type: Ball joint and head integral with mounting flange Integral with mounting flange.
 - c. Shower Head Material: Metallic with chrome-plated finish.
 - d. Spray Pattern: Adjustable.
 - e. Integral Volume Control: Required.
 - f. Shower-Arm, Flow-Control Fitting: 2.0 gpm (7.6 L/min.).
 - g. Temperature Indicator: Integral with faucet.

2.3 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Non-shrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Assemble shower components according to manufacturers' written instructions.
- B. Install showers level and plumb according to roughing-in drawings.
- C. Install water-supply piping with stop on each supply to each shower faucet.
 1. Exception: Use ball or gate valves if supply stops are not specified with shower. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."

- 2. Install stops in locations where they can be easily reached for operation.
- D. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- E. Set shower receptors in leveling bed of cement grout.
- F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheons requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- G. Seal joints between showers and floors and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.2 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with traps and soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.3 ADJUSTING

- A. Operate and adjust showers and controls. Replace damaged and malfunctioning showers, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.

3.4 CLEANING AND PROTECTION

- A. After completing installation of showers, inspect and repair damaged finishes.
- B. Clean showers, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed fixtures and fittings.
- D. Do not allow use of showers for temporary facilities unless approved in writing by Owner.

END OF SECTION 224223

SECTION 224713
DRINKING FOUNTAINS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes drinking fountains and related components.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of drinking fountains.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For drinking fountains to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 DRINKING FOUNTAINS

- A. Drinking Fountains: Stainless steel, wall mounted.

1. Stainless-Steel Drinking Fountains:

- a. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

- 1) [Elkay Manufacturing Co.](#)
- 2) [Haws Corporation.](#)

2. Standards:

- a. Comply with ASME A112.19.3/CSA B45.4.
- b. Comply with NSF 61 Annex G.
- 3. Type Receptor: With back.
- 4. Receptor Shape: Round.
- 5. Back Panel: Stainless-steel wall plate behind drinking fountain.
- 6. Bubblers: Two, with adjustable stream regulator, located on deck.
- 7. Control: Push button.
- 8. Drain: Grid type with NPS 1-1/4 tailpiece.
- 9. Supply Piping: NPS 3/8 with shutoff valve.
- 10. Drain Piping: ASME A112.18.2/CSA B125.2, NPS 1-1/4 chrome-plated brass P-trap and waste.
- 11. Support: ASME A112.6.1M, Type III lavatory carrier.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls and floors for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- B. Set pedestal drinking fountains on floor.
- C. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
- D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball or gate valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."
- E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- G. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- H. Adjust fixture flow regulators for proper flow and stream height.

3.3 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Install ball or gate shutoff valve on water supply to each fixture. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."
- D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 CLEANING

- A. After installation, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.
- C. Provide protective covering for installed fixtures.
- D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224713

DIVISION 23

TABLE OF CONTENTS

DIVISION 23 - HEATING VENTILATING AND AIR CONDITIONING

230513	COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
230516	EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING
230517	SLEEVES AND SLEEVE SEALS FOR HVAC PIPING
230519	METERS AND GAGES FOR HVAC PIPING
230529	HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
230548	VIBRATION AND SEISMIC CONTROLS FOR HVAC
230553	IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
230593	TESTING, ADJUSTING, AND BALANCING FOR HVAC
230713	DUCT INSULATION
231123	FACILITY NATURAL-GAS PIPING
232113	HYDRONIC PIPING
232116	HYDRONIC PIPING SPECIALTIES
232123	HYDRONIC PUMPS
232300	REFRIGERANT PIPING
232513	WATER TREATMENT FOR CLOSED-LOOP HYDRONIC SYSTEMS
233113	METAL DUCTS
233300	AIR DUCT ACCESSORIES
233423	HVAC POWER VENTILATORS
233439	HIGH VOLUME LOW SPEED FANS
233713	DIFFUSERS, REGISTERS, AND GRILLES
233813	COMMERCIAL-KITCHEN HOODS
235116	FABRICATED BREECHINGS AND ACCESSORIES
235216	CONDENSING BOILERS
235416.13	GAS FIRED FURNACES
235523.13	LOW INTENSITY GAS FIRED RADIANT HEATERS
236200	PACKAGED COMPRESSOR AND CONDENSER UNITS
238126	SPLIT-SYSTEM AIR-CONDITIONERS
238239.19	WALL AND CEILING UNIT HEATERS
238316 fl	RADIANT-HEATING HYDRONIC PIPING

END OF TABLE OF CONTENTS

SECTION 230513

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 5500 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.

- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Rotor: Random-wound, squirrel cage.
- F. Bearings: Re-greasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating.
- H. Insulation: Class F.
- I. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Pre-lubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

SECTION 230516

EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Slip-joint, packed expansion joints.
2. Metal, compensator packless expansion joints.
3. Rubber union connector packless expansion joints.
4. Flexible-hose packless expansion joints.
5. Externally pressurized metal-bellows packless expansion joints.
6. Alignment guides and anchors.
7. Pipe loops and swing connections.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Delegated-Design Submittal: For each anchor and alignment guide, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
3. Alignment Guide Details: Detail field assembly and attachment to building structure.
4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

- B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

2.2 PACKED EXPANSION JOINTS

A. Slip-Joint Packed Expansion Joints:

1. Standard: ASTM F 1007.
2. Material: Carbon steel with asbestos-free PTFE packing.
3. Design: With internal guide and injection ports for repacking under full system pressure. Housing shall be furnished with drain ports and lifting ring. Include drip connection if used for steam piping.
4. Configuration: Single joint class(es), unless otherwise indicated.
5. Slip Tube for sizes NPS 1-1/2 through NPS 16: Schedule 80.
6. Sliding Surface: 2 mil thick chrome finish.
7. End Connections: Flanged or welded ends to match piping system.

2.3 PACKLESS EXPANSION JOINTS

A. Metal, Compensator Packless Expansion Joints:

1. Minimum Pressure Rating: 150 psig, unless otherwise indicated.
2. Description: Totally enclosed, externally pressurized, multi-ply bellows isolated from fluid flow by an internal pipe sleeve and external housing.
3. Joint Axial Movement: 2 inches of compression and 1/2 inch of extension.
4. Configuration for Copper Tubing: Multi-ply, phosphor-bronze bellows with copper pipe ends.
 - a. End Connections for Copper Tubing NPS 2 and Smaller: Solder joint or threaded.
 - b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4: Threaded.
5. Configuration for Steel Piping: Multi-ply, stainless-steel bellows; steel-pipe end connections; and carbon-steel shroud.
 - a. End Connections for Steel Pipe NPS 2 and Smaller: Threaded.
 - b. End Connections for Steel Pipe NPS 2-1/2 to NPS 4: Welded.

B. Rubber Union Connector Expansion Joints:

1. Material: Twin reinforced-rubber spheres with external restraining cables.
2. Minimum Pressure Rating: 150 psig at 170 deg F, unless otherwise indicated.

3. End Connections for NPS 2 and Smaller: Threaded.

C. Flexible-Hose Packless Expansion Joints:

1. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
2. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
3. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with solder-joint end connections.
 - a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.
4. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4: Copper-alloy fittings with threaded end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.
5. Expansion Joints for Steel Piping NPS 2 and Smaller: Carbon-steel fittings with threaded end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig at 70 deg F and 325 psig at 600 deg F ratings.
6. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6: Carbon-steel fittings with welded end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F and 145 psig at 600 deg F ratings.

D. Externally Pressurized Metal-Bellows Packless Expansion Joints:

1. Minimum Pressure Rating: 150 psig, unless otherwise indicated.
2. Description:
 - a. Totally enclosed, externally pressurized, multi-ply, stainless-steel bellows isolated from fluid flow by an internal pipe sleeve.
 - b. Carbon-steel housing.
 - c. Drain plugs and lifting lug for the NPS 3 and larger.
 - d. Bellows shall have operating clearance between the internal pipe sleeves and the external shrouds.
 - e. Joints shall be supplied with a built-in scale to confirm the starting position and operating movement.
 - f. Joint Axial Movement: 4 inches of compression and of extension.
3. Permanent Locking Bolts: Set locking bolts to maintain joint lengths during installation. Temporary welding tabs that are removed after installation in lieu of locking bolts are not acceptable.
4. End Connection Configuration: Flanged; one raised, fixed and one floating flange.

2.4 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

1. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding slider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
 - a. Stud: Threaded, zinc-coated carbon steel.
 - b. Expansion Plug: Zinc-coated steel.
 - c. Washer and Nut: Zinc-coated steel.
5. Chemical Fasteners: Insert-type stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
 - a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
 - b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
 - c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.1 EXPANSION JOINT INSTALLATION

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.
- B. Install packed-type expansion joints with packing suitable for fluid service.
- C. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."

3.2 PIPE LOOP AND SWING CONNECTION INSTALLATION

- A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.

- C. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.
- D. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

- A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
- B. Install one guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.
- C. Attach guides to pipe, and secure guides to building structure.
- D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- E. Anchor Attachments:
 - 1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24; U bolts bolted to anchor.
- F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
 - 1. Anchor Attachment to Steel Structural Members: Attach by welding.
 - 2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
- G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 230516

SECTION 230517

SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Sleeve-seal systems.
 - 3. Grout.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 SLEEVE-SEAL SYSTEMS

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Stainless steel.

3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Non-shrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 1. Cut sleeves to length for mounting flush with both surfaces.
 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior Concrete Walls above Grade:
 - a. Piping Smaller Than NPS 6: Cast-iron wall sleeves.
 - b. Piping NPS 6 and Larger: Cast-iron wall sleeves.
 - 2. Exterior Concrete Walls below Grade:
 - a. Piping : Cast-iron wall sleeves with sleeve-seal system].
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - 3. Concrete Slabs-on-Grade:
 - a. Piping : Cast-iron wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - 4. Concrete Slabs above Grade:
 - a. Piping : PVC-pipe sleeves.
 - 5. Interior Partitions:
 - a. Piping : Galvanized-steel-sheet sleeves.

END OF SECTION 230517

SECTION 230519

METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bimetallic-actuated thermometers.
2. Liquid-in-glass thermometers.
3. Thermowells.
4. Dial-type pressure gages.
5. Gage attachments.
6. Pitot-tube flowmeters.
7. Turbine flowmeters.
8. Venturi flowmeters.
9. Impeller-turbine, thermal-energy meters.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Wiring Diagrams: For power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. Product certificates.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

- A. Standard: ASME B40.200.
- B. Case: Liquid-filled and sealed type(s); stainless steel with 3-inch nominal diameter.
- C. Dial: Non-reflective aluminum with permanently etched scale markings and scales in deg F
- D. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.

- E. Connector Size: 1/2 inch, with ASME B1.1 screw threads.
- F. Stem: 0.25 or 0.375 inch in diameter; stainless steel.
- G. Window: plastic.
- H. Ring: Stainless steel.
- I. Element: Bimetal coil.
- J. Pointer: Dark-colored metal.
- K. Accuracy: Plus or minus 1 percent of scale range.

2.2 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Standard: ASME B40.200.
2. Case: Cast aluminum; 7-inch nominal size unless otherwise indicated.
3. Case Form: Adjustable angle unless otherwise indicated.
4. Tube: Glass with magnifying lens and blue[or red] organic liquid.
5. Tube Background: Non-reflective aluminum with permanently etched scale markings graduated in deg F.
6. Window: plastic.
7. Stem: Aluminum and of length to suit installation.
 - a. Design for Air-Duct Installation: With ventilated shroud.
 - b. Design for Thermowell Installation: Bare stem.
8. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
9. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

B. Plastic-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Standard: ASME B40.200.
2. Case: Plastic; 7-inch nominal size unless otherwise indicated.
3. Case Form: Adjustable angle unless otherwise indicated.
4. Tube: Glass with magnifying lens and blue organic liquid.
5. Tube Background: Non-reflective aluminum with permanently etched scale markings graduated in deg F.
6. Window: plastic.
7. Stem: Aluminum and of length to suit installation.
 - a. Design for Air-Duct Installation: With ventilated shroud.
 - b. Design for Thermowell Installation: Bare stem.
8. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
9. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.3 DUCT-THERMOMETER MOUNTING BRACKETS

- A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

2.4 THERMOWELLS

- A. Thermowells:
 1. Standard: ASME B40.200.
 2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
 3. Material for Use with Copper Tubing: CNR or CUNI.
 4. Material for Use with Steel Piping: CRES.
 5. Type: Stepped shank unless straight or tapered shank is indicated.
 6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
 7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
 8. Bore: Diameter required to match thermometer bulb or stem.
 9. Insertion Length: Length required to match thermometer bulb or stem.
 10. Lagging Extension: Include on thermowells for insulated piping and tubing.
 11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
- B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.5 PRESSURE GAGES

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
 1. Standard: ASME B40.100.
 2. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
 3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 4. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 5. Movement: Mechanical, with link to pressure element and connection to pointer.
 6. Dial: Non-reflective aluminum with permanently etched scale markings graduated in psi.
 7. Pointer: Dark-colored metal.
 8. Window: plastic.
 9. Ring: Metal.
 10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.
- B. Direct-Mounted, Plastic-Case, Dial-Type Pressure Gages:
 1. Standard: ASME B40.100.
 2. Case: Sealed type; plastic; 4-1/2-inch nominal diameter.
 3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 4. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 5. Movement: Mechanical, with link to pressure element and connection to pointer.
 6. Dial: Non-reflective aluminum with permanently etched scale markings graduated in psi.
 7. Pointer: Dark-colored metal.
 8. Window: plastic.
 9. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

C. Remote-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Standard: ASME B40.100.
2. Case: Liquid-filled type; cast aluminum or drawn steel; 4-1/2-inch nominal diameter with back flange and holes for panel mounting.
3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
4. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Non-reflective aluminum with permanently etched scale markings graduated in psi.
7. Pointer: Dark-colored metal.
8. Window: plastic.
9. Ring: Metal.
10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.6 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
- B. Siphons: Loop-shaped section of stainless-steel pipe with NPS 1/4 or NPS 1/2 pipe threads.
- C. Valves: Brass ball, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.7 FLOWMETERS

A. Pitot-Tube Flowmeters:

1. Description: Flowmeter with sensor and indicator.
2. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
3. Sensor: Insertion type; for inserting probe into piping and measuring flow directly in gallons per minute.
 - a. Design: Differential-pressure-type measurement for [oil] [water] <Insert fluid>.
 - b. Construction: Stainless-steel probe of length to span inside of pipe, with integral transmitter and direct-reading scale.
 - c. Minimum Pressure Rating: 150 psig.
 - d. Minimum Temperature Rating: 250 deg F.
4. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.
5. Integral Transformer: For low-voltage power connection.
6. Accuracy: Plus or minus 2 percent.
7. Display: Shows rate of flow, with register to indicate total volume in gallons.
8. Operating Instructions: Include complete instructions with each flowmeter.

B. Turbine Flowmeters:

1. Description: Flowmeter with sensor and indicator.
2. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.

3. Sensor: Impeller turbine; for inserting into pipe fitting or for installing in piping and measuring flow directly in gallons per minute.
 - a. Design: Device or pipe fitting with inline turbine and integral direct-reading scale for water.
 - b. Construction: Bronze or stainless-steel body, with plastic turbine or impeller.
 - c. Minimum Pressure Rating: 150 psig.
 - d. Minimum Temperature Rating: 180 deg F.
4. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.
5. Accuracy: Plus or minus 1-1/2 percent.
6. Display: Shows rate of flow, with register to indicate total volume in gallons.
7. Operating Instructions: Include complete instructions with each flowmeter.

C. Venturi Flowmeters:

1. Description: Flowmeter with calibrated flow-measuring element, hoses or tubing, fittings, valves, indicator, and conversion chart.
2. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
3. Sensor: Venturi-type, calibrated, flow-measuring element; for installation in piping.
 - a. Design: Differential-pressure-type measurement for water.
 - b. Construction: Bronze, brass, or factory-primed steel, with brass fittings and attached tag with flow conversion data.
 - c. Minimum Pressure Rating: 250 psig.
 - d. Minimum Temperature Rating: 250 deg F.
 - e. End Connections for NPS 2 and Smaller: Threaded.
 - f. End Connections for NPS 2-1/2 and Larger: Flanged or welded.
 - g. Flow Range: Flow-measuring element and flowmeter shall cover operating range of equipment or system served.
4. Permanent Indicators: Meter suitable for wall or bracket mounting, calibrated for connected flowmeter element, and having 6-inch-diameter, or equivalent, dial with fittings and copper tubing for connecting to flowmeter element.
 - a. Scale: Gallons per minute.
 - b. Accuracy: Plus or minus 1 percent between 20 and 80 percent of scale range.
5. Portable Indicators: Hand-held, differential-pressure type, calibrated for connected flowmeter element and having two 12-foot hoses, with carrying case.
 - a. Scale: Gallons per minute.
 - b. Accuracy: Plus or minus 2 percent between 20 and 80 percent of scale range.
6. Display: Shows rate of flow, with register to indicate total volume in gallons.
7. Conversion Chart: Flow rate data compatible with sensor.
8. Operating Instructions: Include complete instructions with each flowmeter.

2.8 THERMAL-ENERGY METERS

A. Impeller-Turbine, Thermal-Energy Meters:

1. Description: System with strainer, flow sensor, temperature sensors, transmitter, indicator, and connecting wiring.
2. Flow Sensor: Impeller turbine with corrosion-resistant-metal body and transmitter; for installing in piping.
 - a. Design: Total thermal-energy measurement.
 - b. Minimum Pressure Rating: 150 psig.
 - c. Minimum Temperature Range: 40 to 250 deg F (5 to 121 deg C).
3. Temperature Sensors: Insertion-type transducer.
4. Indicator: Solid-state, integrating-type meter with integral battery pack; for wall mounting.
 - a. Data Output: Six-digit electromechanical counter with readout in kilowatts per hour or British thermal units.
 - b. Battery Pack: Five-year lithium battery.
5. Accuracy: Plus or minus 1 percent.
6. Display: Visually indicates total fluid volume in gallons and thermal-energy flow in kilowatts per hour or British thermal units.
7. Strainer: Full size of main line piping.
8. Operating Instructions: Include complete instructions with each thermal-energy meter system.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
- G. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.
- H. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- I. Install remote-mounted pressure gages on panel.
- J. Install valve and snubber in piping for each pressure gage for fluids (except steam).
- K. Install valve and syphon fitting in piping for each pressure gage for steam.

- L. Install flow indicators in piping systems in accessible positions for easy viewing.
- M. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.
- N. Install flowmeter elements in accessible positions in piping systems.
- O. Install differential-pressure-type flowmeter elements, with at least minimum straight lengths of pipe, upstream and downstream from element according to manufacturer's written instructions.
- P. Install permanent indicators on walls or brackets in accessible and readable positions.
- Q. Install connection fittings in accessible locations for attachment to portable indicators.
- R. Mount thermal-energy meters on wall if accessible; if not, provide brackets to support meters.
- S. Install thermometers in the following locations:
 - 1. Inlet and outlet of each hydronic zone.
 - 2. Inlet and outlet of each hydronic boiler.
 - 3. Two inlets and two outlets of each chiller.
 - 4. Inlet and outlet of each hydronic coil in air-handling units.
 - 5. Two inlets and two outlets of each hydronic heat exchanger.
 - 6. Inlet and outlet of each thermal-storage tank.
 - 7. Outside-, return-, supply-, and mixed-air ducts.
- T. Install pressure gages in the following locations:
 - 1. Discharge of each pressure-reducing valve.
 - 2. Inlet and outlet of each chiller chilled-water and condenser-water connection.
 - 3. Suction and discharge of each pump.

3.2 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.
- B. Connect flowmeter-system elements to meters.
- C. Connect flowmeter transmitters to meters.
- D. Connect thermal-energy meter transmitters to meters.

3.3 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each hydronic zone shall be[one of] the following:
 - 1. Liquid-filled, bimetallic-actuated type.
 - 2. Industrial-style, liquid-in-glass type.
- B. Thermometers at inlet and outlet of each hydronic boiler shall be one of the following:
 - 1. Liquid-filled, bimetallic-actuated type.
 - 2. Industrial-style, liquid-in-glass type.
- C. Thermometers at inlets and outlets of each chiller shall be one of the following:
 - 1. Liquid-filled, bimetallic-actuated type.
 - 2. Industrial-style, liquid-in-glass type.
- D. Thermometers at inlet and outlet of each hydronic coil in air-handling units and built-up central systems shall be one of the following:
 - 1. Liquid-filled, bimetallic-actuated type.
 - 2. Industrial-style, liquid-in-glass type.
- E. Thermometers at inlets and outlets of each hydronic heat exchanger shall be one of the following:
 - 1. Liquid-filled, bimetallic-actuated type.
 - 2. Industrial-style, liquid-in-glass type.
- F. Thermometers at inlet and outlet of each hydronic heat-recovery unit shall be[one of] the following:
 - 1. Liquid-filled, bimetallic-actuated type.
 - 2. Industrial-style, liquid-in-glass type.
- G. Thermometers at inlet and outlet of each thermal-storage tank shall be one of the following:
 - 1. Liquid-filled, bimetallic-actuated type.
 - 2. Industrial-style, liquid-in-glass type.
- H. Thermometers at outside-, return-, supply-, and mixed-air ducts shall be one of the following:
 - 1. Liquid-filled, bimetallic-actuated type.
 - 2. Industrial-style, liquid-in-glass type.
- I. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Chilled-Water Piping: 0 to 100 deg F.
- B. Scale Range for Condenser-Water Piping: 0 to 150 deg F.

- C. Scale Range for Heating, Hot-Water Piping: 20 to 240 deg F.
- D. Scale Range for Steam and Steam-Condensate Piping: 20 to 240 deg F.
- E. Scale Range for Air Ducts: 0 to 150 deg F.

3.6 PRESSURE-GAGE SCHEDULE

- A. Pressure gages at discharge of each pressure-reducing valve shall be the following:
 - 1. Liquid-filled, direct-mounted, metal case.
- B. Pressure gages at inlet and outlet of each chiller chilled-water and condenser-water connection shall be the following:
 - 1. Liquid-filled, direct-mounted, metal case.
- C. Pressure gages at suction and discharge of each pump shall be the following:
 - 1. Liquid-filled, direct-mounted, metal case.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Hydronic Piping: 0 to 100 psi.
- B. Scale Range for Steam Piping: 0 to 160 psi.

3.8 FLOWMETER SCHEDULE

- A. Flowmeters for Chilled-Water Piping: Pitot-tube, Turbine, or Venturi type.
- B. Flowmeters for Condenser-Water Piping: Pitot-tube, Turbine, or Venturi type.
- C. Flowmeters for Heating, Hot-Water Piping: Pitot-tube, Turbine, or Venturi type.
- D. Flowmeters for Steam and Steam-Condensate Piping: Venturi type.

3.9 THERMAL-ENERGY METER SCHEDULE

- A. Thermal-Energy Meters: Impeller-turbine type.

END OF SECTION 230519

SECTION 230529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Metal pipe hangers and supports.
 2. Trapeze pipe hangers.
 3. Thermal-hanger shield inserts.
 4. Fastener systems.
 5. Equipment supports.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
1. Trapeze pipe hangers.
 2. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pre-galvanized or hot dipped.
 - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Stainless-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- C. Copper Pipe Hangers:
 - 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
 - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

- B. Insulation-Insert Material for Hot Piping: ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psi minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.6 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Non-staining, non-corrosive, and non-gaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation:
1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- H. Install lateral bracing with pipe hangers and supports to prevent swaying.
- I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- L. Insulated Piping:
1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

- a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
- 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
- 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
- 5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
- 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and 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. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in architectural specifications.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
 5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 6. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 8. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
 9. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

SECTION 230548

VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Open-spring isolators.
5. Housed-spring isolators.
6. Restrained-spring isolators.
7. Housed-restrained-spring isolators.
8. Pipe-riser resilient supports.
9. Resilient pipe guides.
10. Elastomeric hangers.
11. Spring hangers.
12. Snubbers.
13. Restraint channel bracings.
14. Restraint cables.
15. Seismic-restraint accessories.
16. Mechanical anchor bolts.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.

1. Include design calculations and details for selecting vibration isolators and seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Field quality-control reports.

1.4 QUALITY ASSURANCE

- ###### A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Wind-Restraint Loading:
 - 1. Ultimate Design Wind Speed: 115 MPH
 - 2. Building Classification Category: II.
 - 3. Minimum 10 lb/sq. ft. multiplied by maximum area of HVAC component projected on vertical plane normal to wind direction, and 45 degrees either side of normal.
- B. Seismic-Restraint Loading:
 - 1. Site Class as Defined in the IBC: D.
 - 2. Assigned Seismic Use Group or Building Category as Defined in the IBC: II.
 - a. Component Importance Factor: 1.0.

2.2 ELASTOMERIC ISOLATION PADS

- A. Elastomeric Isolation Pads: .
 - 1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
 - 2. Size: Factory or field cut to match requirements of supported equipment.
 - 3. Pad Material: Oil and water resistant with elastomeric properties.
 - 4. Surface Pattern: Waffle pattern.
 - 5. Infused nonwoven cotton or synthetic fibers.
 - 6. Load-bearing metal plates adhered to pads.

2.3 ELASTOMERIC ISOLATION MOUNTS

- A. Double-Deflection, Elastomeric Isolation Mounts: .
 - 1. Mounting Plates:
 - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.

- b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
2. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.4 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts: .

1. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - a. Housing: Cast-ductile iron or welded steel.
 - b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.5 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators: .

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.6 HOUSED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing: .

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
 - b. Top housing with attachment and leveling bolt.

2.7 RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint: .
1. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
 - a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
 - b. Top plate with threaded mounting holes.
 - c. Internal leveling bolt that acts as blocking during installation.
 2. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.8 HOUSED-RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing: .
1. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
 - b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.9 PIPE-RISER RESILIENT SUPPORT

- A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch-thick neoprene.
1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
 2. Maximum Load Per Support: 500 psigon isolation material providing equal isolation in all directions.

2.10 RESILIENT PIPE GUIDES

- A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch-thick neoprene.
1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and re-insertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.11 ELASTOMERIC HANGERS

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods: .
1. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.12 SPRING HANGERS

- A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression: .
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 8. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.13 SNUBBERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. [Kinetics Noise Control, Inc.](#)
 2. [Mason Industries, Inc.](#)
 3. [Vibration Mountings & Controls, Inc.](#)

- B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 3. Maximum 1/4-inch air gap, and minimum 1/4-inch-thick resilient cushion.

2.14 RESTRAINT CHANNEL BRACINGS

- A. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.15 RESTRAINT CABLES

- A. Restraint Cables: ASTM A 603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.16 SEISMIC-RESTRAINT ACCESSORIES

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
1. [B-line, an Eaton business.](#)
 2. [Kinetics Noise Control, Inc.](#)
 3. [Mason Industries, Inc.](#)
- B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES.
- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.2 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete." [Section 033053 "Miscellaneous Cast-in-Place Concrete."
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- C. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- D. Equipment Restraints:
 - 1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 - 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES that provides required submittals for component.
- E. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
 - 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 - 3. Brace a change of direction longer than 12 feet.
- F. Install cables so they do not bend across edges of adjacent equipment or building structure.
- G. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES that provides required submittals for component.
- H. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

- I. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- J. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- K. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-stressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.3 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 232113 "Hydronic Piping" for piping flexible connections.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless post-connection testing has been approved), and with at least seven days' advance notice.
 - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 - 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 - 5. Test to 90 percent of rated proof load of device.
 - 6. Measure isolator restraint clearance.
 - 7. Measure isolator deflection.
 - 8. Verify snubber minimum clearances.

- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

END OF SECTION 230548

SECTION 230553

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Equipment labels.
 2. Warning signs and labels.
 3. Pipe labels.
 4. Duct labels.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
1. Material and Thickness: aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 2. Letter Color: Black.
 3. Background Color: White.
 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
 6. Fasteners: Stainless-steel rivets or self-tapping screws.
 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
 2. Letter Color: Black.
 3. Background Color: White.
 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: White.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.
- B. Pre-tensioned Pipe Labels: Pre-coiled, semi-rigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

2.4 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: White.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.

- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified by architect.
- B. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- C. Pipe Label Color Schedule:
 - 1. Chilled-Water Piping: White letters on a safety-green background.
 - 2. Condenser-Water Piping: White letters on a safety-green background.
 - 3. Heating Water Piping: White letters on a safety-green background.
 - 4. Refrigerant Piping: Black letters on a safety-orange background.
 - 5. Low-Pressure Steam Piping: White letters on a safety-purple background.
 - 6. High-Pressure Steam Piping: White letters on a safety-purple background.
 - 7. Steam Condensate Piping: White letters on a safety-purple background.

3.4 DUCT LABEL INSTALLATION

- A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
 - 1. Blue: For cold-air supply ducts.
 - 2. Yellow: For hot-air supply ducts.
 - 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
- B. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

END OF SECTION 230553

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Balancing Air Systems:
 - a. Constant-volume air systems.

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 15 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. Certified TAB reports.
- E. Sample report forms.
- F. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.5 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC or NEBB.
 1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC or NEBB.
 2. TAB Technician: Employee of the TAB contractor and who is certified by AABC or NEBB as a TAB technician.
- B. Certify TAB field data reports and perform the following:
 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- C. TAB Report Forms: Use standard TAB contractor's forms approved by Owner.
- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."
- E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- F. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.6 PROJECT CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed.

PART 2 - SCOPE

- A. Balance new furnaces and exhaust fans. Balance outside air to CFM indicated on drawings.

Ensure proper operation of all economizers. Indicate any deficiencies in flow or problems with operation of equipment and any possibly reasons for problems.

PART 3 - EXECUTION

3.1 TAB SPECIALISTS

- A. Subject to compliance with requirements, engage one of the following:
 - 1. Certified Test and Balance.
 - 2. Bonneville Test and Balance.
 - 3. BTC Test and Balance.
 - 4. Diamond Test and Balance.
 - 5. R and S Analysis
 - 6. Intermountain Test and Balance
 - 7. Test and Balancing, Inc.
 - 8. Independent Test and Balance

3.2 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- F. Examine test reports specified in individual system and equipment Sections.
- G. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- H. Examine terminal units; such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- I. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- J. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- K. Examine operating safety interlocks and controls on HVAC equipment.

- L. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Automatic temperature-control systems are operational.
 - 3. Equipment and duct access doors are securely closed.
 - 4. Balance, smoke, and fire dampers are open.
 - 5. Isolating and balancing valves are open and control valves are operational.
 - 6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 7. Windows and doors can be closed so indicated conditions for system operations can be met.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance", or ASHRAE 111-1988, or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems".
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 - 2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 23 33 00 "Air Duct Accessories."
 - 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 23 07 13 "Duct Insulation," Section 23 07 16 "HVAC Equipment Insulation," and Section 23 07 19 "HVAC Piping Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. All instruments used by the Contractor shall have been calibrated within the previous 12 months. The final balance report shall contain copies of calibration documents showing calibration tolerances, date of calibration and calibrating firm.
- E. Air and water quantities shall be balanced to within 5% of the quantities shown.
- F. Balance air flow at duct branch damper with outlet dampers full open.
- G. Test, adjust and record fan RPM to design requirements, record initial and final readings.

- H. Test and record motor amps, initial and final readings.
- I. Make pitot tube traverse readings of main ducts and obtain design CFM for supply, return and outside air systems by adjusting fans and dampers.
- J. Test and record systems static pressures, suction and discharge; record initial and final readings.
- K. Test and adjust each terminal unit.
- L. Check and record inlet static pressures and modulation limit CFM values, initial and final readings after adjustments.
- M. The Balancing Contractor shall have a Controls Mechanic available at all times to assist the balancing personnel in adjusting control devices.
- N. Clearly mark the final position of all dampers, diffusers, reheat boxes, etc. with permanent identification material, neatly applied so as to be easily read and understood.
- O. Confusing or illegible markings shall be removed and reapplied as directed by the Project Manager.
- P. All mechanical HVAC systems, air and water, shown on the plans shall be tested and adjusted to design flow. If heating air flow values are different than cooling, provide certification that heating CFM values are within design.
- Q. Replace sheaves and drives where required to meet design conditions.
- R. Copies of a formal balance report shall be prepared and submitted for inclusion in the Operation and Maintenance Manuals. The report shall contain a complete, legible schedule of:
 - a. All equipment outlets/inlets and their respective flows
 - b. Pitot tube traverse readings and associated calculations
 - c. Reheat box settings, GPM and CFM
 - d. Box static pressures at inlets
 - e. Box CFM limits (maximum and minimum)
 - f. Status of each pump and fan, including RPM, AMPS, suction and discharge static pressures, and flow rates.
 - g. A set of master plans shall be bound with the schedules (11" x 17" maximum) identifying the location of each inlet/outlet and device tested.
 - h. Calibration documents

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and

recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Section 23 31 13 "Metal Ducts."

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Where sufficient spaces in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
 - 2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

- a. Report the cleanliness status of filters and the time static pressures are measured.
 - 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 - 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 - 6. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 - 7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
- 1. Measure airflow of submain and branch ducts.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 - 2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
 - 3. Re-measure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
- 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
- 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 - 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.7 PROCEDURES FOR DUAL-DUCT SYSTEMS

- A. Verify that the cooling coil is capable of full-system airflow, and set mixing boxes at full-cold airflow position for fan volume.
- B. Measure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate controls of mixing boxes and to

overcome resistance in the ducts and outlets downstream from mixing boxes.

1. If insufficient static pressure exists, increase airflow at the fan.

C. Test and adjust the constant-volume mixing boxes as follows:

1. Verify both hot and cold operations by adjusting the thermostat and observing changes in air temperature and volume.
2. Verify sufficient inlet static pressure before making volume adjustments.
3. Adjust mixing boxes to indicated airflows within specified tolerances. Measure airflow by Pitot-tube traverse readings or by measuring static pressure at mixing-box taps if provided by mixing-box manufacturer.

D. Do not over pressurize ducts.

E. Re-measure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate controls of mixing boxes and to overcome resistance in the ducts and outlets downstream from mixing boxes.

F. Adjust variable-air-volume, dual-duct systems in the same way as constant-volume, dual-duct systems; adjust maximum- and minimum-airflow setting of each mixing box.

3.8 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.9 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:

1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

- B. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
 - 1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
 - 2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
 - 3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
 - 4. Balance each air outlet.

3.10 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 5 percent.
 - 2. Air Outlets and Inlets: Plus or minus 5 percent.
 - 3. Heating-Water Flow Rate: Plus or minus 5 percent.
 - 4. Cooling-Water Flow Rate: Plus or minus 5 percent.

3.11 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 - 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.
 - 3. Manufacturers' test data.
 - 4. Field test reports prepared by system and equipment installers.
 - 5. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
 - 1. Title page.
 - 2. Name and address of the TAB contractor.
 - 3. Project name.
 - 4. Project location.
 - 5. Engineer's name and address.
 - 6. Contractor's name and address.
 - 7. Report date.
 - 8. Signature of TAB supervisor who certifies the report.
 - 9. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.

10. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 11. Nomenclature sheets for each item of equipment.
 12. Data for terminal units, including manufacturer's name, type, size, and fittings.
 13. Notes to explain why certain final data in the body of reports vary from indicated values.
 14. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
 2. Water and steam flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Terminal units.
 6. Balancing stations.
 7. Position of balancing devices.
- E. Air-Terminal-Device Reports:
1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Apparatus used for test.
 - d. Area served.
 - e. Make.
 - f. Number from system diagram.
 - g. Type and model number.
 - h. Size.
 - i. Effective area in sq. ft.
 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm (L/s).
 - b. Air velocity in fpm (m/s).
 - c. Preliminary air flow rate as needed in cfm (L/s).
 - d. Preliminary velocity as needed in fpm (m/s).
 - e. Final air flow rate in cfm (L/s).
 - f. Final velocity in fpm (m/s).
 - g. Space temperature in deg F (deg C).

F. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

- a. System and air-handling-unit identification.
- b. Location and zone.
- c. Room or riser served.
- d. Coil make and size.
- e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

- a. Air flow rate in cfm (L/s).
- b. Entering-water temperature in deg F (deg C).
- c. Leaving-water temperature in deg F (deg C).
- d. Water pressure drop in feet of head or psig (kPa).
- e. Entering-air temperature in deg F (deg C).
- f. Leaving-air temperature in deg F (deg C).

G. Instrument Calibration Reports:

1. Report Data:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

3.12 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:
 - a. Measure airflow of at least 10 percent of air outlets.
 - b. Measure water flow of at least 10 percent of terminals.
 - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - d. Verify that balancing devices are marked with final balance position.
 - e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Engineer.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Owner.
3. Engineer shall randomly select measurements, documented in the final report, to be

rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
 5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:
1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
 2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.
- D. Prepare test and inspection reports.

3.13 ADDITIONAL TESTS

- A. The Test and Balance Contractor shall include an extended warranty of 90 days after the completion of the project, during which time the Owner may request a recheck or re-set of any outlet, inlet, control, or mechanical unit.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 23 05 93

SECTION 230713

DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes insulating the following duct services:
 - 1. Indoor, concealed supply and outdoor air.
 - 2. Indoor, exposed supply and outdoor air.
 - 3. Outdoor, concealed supply and return.
 - 4. Outdoor, exposed supply and return.
- B. Related Sections:
 - 1. Section 230719 "HVAC Piping Insulation."
 - 2. Section 233113 "Metal Ducts" for duct liners.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
 - 1. For adhesives and sealants, documentation including printed statement of VOC content.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Provide fiberglass faced duct wrap Type IV with factory applied flame retardant foil reinforced Kraft facing FRK-25, U.L. Label.

2.2 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. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. [Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.](#)
 - b. [Eagle Bridges - Marathon Industries; 225.](#)
 - c. [Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.Mon-Eco Industries, Inc.; 22-25.](#)

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
 1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. [Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.](#)
 - b. [Vimasco Corporation; 749.](#)
 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 5. Color: White.

2.4 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2.5 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. [ABI, Ideal Tape Division; 428 AWF ASJ.](#)
 - b. [Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.](#)
 - c. [Compac Corporation; 104 and 105.](#)
 - d. [Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.](#)
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
 1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. [ABI, Ideal Tape Division; 488 AWF.](#)
 - b. [Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.](#)
 - c. [Compac Corporation; 120.](#)
 - d. [Venture Tape; 3520 CW.](#)
 2. Width: 2 inches.
 3. Thickness: 3.7 mils.
 4. Adhesion: 100 ounces force/inch in width.
 5. Elongation: 5 percent.
 6. Tensile Strength: 34 lbf/inch in width.

2.6 SECUREMENTS

A. Bands:

1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. **ITW Insulation Systems;** Gerrard Strapping and Seals.
 - b. **RPR Products, Inc.;** Insul-Mate Strapping, Seals, and Springs.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing seal or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal 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 and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated.
 - a. **Products:** Subject to compliance with requirements, provide one of the following:
 - 1) **AGM Industries, Inc.;** CWP-1.
 - 2) **GEMCO;** CD.
 - 3) **Midwest Fasteners, Inc.;** CD.
 - 4) **Nelson Stud Welding;** TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - a. **Products:** Subject to compliance with requirements, provide one of the following:
 - 1) **AGM Industries, Inc.;** CHP-1.
 - 2) **GEMCO;** Cupped Head Weld Pin.
 - 3) **Midwest Fasteners, Inc.;** Cupped Head.
 - 4) **Nelson Stud Welding;** CHP.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. **Products:** Subject to compliance with requirements, provide one of the following:
 - 1) **AGM Industries, Inc.;** Tactoo Perforated Base Insul-Hangers.
 - 2) **GEMCO;** Perforated Base.
 - 3) **Midwest Fasteners, Inc.;** Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low-carbon steel, aluminum, or stainless steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. **Products:** Subject to compliance with requirements, provide one of the following:
 - 1) **GEMCO;** Nylon Hangers.
 - 2) **Midwest Fasteners, Inc.;** Nylon Insulation Hangers.
 - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.

- d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 - 5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. **Products:** Subject to compliance with requirements, provide one of the following:
 - 1) [AGM Industries, Inc.](#); Tactoo Self-Adhering Insul-Hangers.
 - 2) [GEMCO](#); Peel & Press.
 - 3) [Midwest Fasteners, Inc.](#); Self Stick.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low-carbon steel, aluminum, or stainless steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
 - 6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel, aluminum, or stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. **Products:** Subject to compliance with requirements, provide one of the following:
 - 1) [AGM Industries, Inc.](#); RC-150.
 - 2) [GEMCO](#); R-150.
 - 3) [Midwest Fasteners, Inc.](#); WA-150.
 - 4) [Nelson Stud Welding](#); Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
 - 7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - 1) [GEMCO](#).
 - 2) [Midwest Fasteners, Inc.](#)
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- D. Wire: 0.062-inch soft-annealed, stainless steel.
- 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [C & F Wire](#).
- 2.7 CORNER ANGLES
- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
 - B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.
 - C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Duct insulation wrap in exposed corridors shall be canvas covered and painted to match existing duct insulation.
- B. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- C. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- D. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- E. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- F. Install multiple layers of insulation with longitudinal and end seams staggered.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c. Adhere insulation with 4" strips of Insulation Bonding Adhesive at 8" on center.
 3. Overlap jacket longitudinal seams at least 2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c. Adhere insulation with 4" strips of Insulation Bonding Adhesive at 8" on center. Cover longitudinal joints with 3-inch wide strips, of same material as insulation jacket.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
 - b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not over-compress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic

applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).

5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
 - b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not over-compress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and

inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.7 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
 2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
 1. Draw jacket material smooth and tight.
 2. Install lap or joint strips with same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.8 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

3.9 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.

- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 1. Inspect ductwork, randomly selected by Engineer, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 1. Indoor, supply, return and outdoor air.
- B. Items Not Insulated:
 1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
 2. Factory-insulated flexible ducts.
 3. Flexible connectors.
 4. Vibration-control devices.
 5. Factory-insulated access panels and doors.

3.12 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, round, rectangular, and flat-oval, supply-air duct insulation shall be the following:
 1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

3.13 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.
- B. Concealed, round, rectangular, and flat-oval, supply and return-air duct insulation shall be R-12 and shall be one of the following:
 1. Mineral-Fiber Blanket: 3 inches (75 mm) and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
 2. Mineral-Fiber Board: 3 inches (75 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

3.14 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Ducts and Plenums, Exposed:
 - 1. Aluminum, Corrugated: 0.040 inch (1.0 mm) thick with a Polyfilm Moisture Barrier (PFMB) coating.

END OF SECTION 230713

SECTION 231123

FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves.
5. Pressure regulators.

1.2 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig (690 kPa) minimum unless otherwise indicated.
2. Service Regulators: 65 psig (450 kPa) minimum unless otherwise indicated.

B. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 0.5 psig (3.45 kPa) but not more than 2 psig (13.8 kPa), and is reduced to secondary pressure of 0.5 psig (3.45 kPa) or less.

C. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

C. Delegated-Design Submittal: For natural-gas piping and equipment indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of seismic restraints.
2. Design Calculations: Calculate requirements for selecting seismic restraints.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
 - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 - 2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
 - 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
 - 4. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
 - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.
- B. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.
 - 1.
 - 2. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.
 - 3. Coating: PE with flame retardant.
 - a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 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: 50 or less.

4. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
 5. Striker Plates: Steel, designed to protect tubing from penetrations.
 6. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
 7. Operating-Pressure Rating: 5 psig (34.5 kPa).
- C. Annealed-Temper Copper Tube: Comply with ASTM B 88, Type L (ASTM B 88M, Type B).
1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.
 2. Flare Fittings: Comply with ASME B16.26 and SAE J513.
 - a. Copper fittings with long nuts.
 - b. Metal-to-metal compression seal without gasket.
 - c. Dryseal threads complying with ASME B1.20.3.
 3. Protective Coating for Underground Tubing: Factory-applied, extruded PE a minimum of 0.022 inch (0.56 mm) thick.
- D. PE Pipe: ASTM D 2513, SDR 11.
1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
 2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
 3. Anodeless Service-Line Risers: Factory fabricated and leak tested.
 - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
 - b. Casing: Steel pipe complying with ASTM A 53/A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering. Vent casing aboveground.
 - c. Aboveground Portion: PE transition fitting.
 - d. Outlet shall be threaded or suitable for welded connection.
 - e. Tracer wire connection.
 - f. Ultraviolet shield.
 - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
 4. Transition Service-Line Risers: Factory fabricated and leak tested.
 - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet connected to steel pipe complying with ASTM A 53/A 53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
 - b. Outlet shall be threaded or suitable for welded connection.
 - c. Bridging sleeve over mechanical coupling.
 - d. Factory-connected anode.
 - e. Tracer wire connection.
 - f. Ultraviolet shield.
 - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

2.2 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: **0.5 psig (3.45 kPa)**.
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: **72 inches (1830 mm.)**

B. Quick-Disconnect Devices: Comply with ANSI Z21.41.

1. Copper-alloy convenience outlet and matching plug connector.
2. Nitrile seals.
3. Hand operated with automatic shutoff when disconnected.
4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

C. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for **NPS 2 (DN 50)** and smaller.
3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: **125 psig (862 kPa)**.

D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.3 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. 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.

C. Brazing Filler Metals: Alloy with melting point greater than **1000 deg F (540 deg C)** complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.4 MANUAL GAS SHUTOFF VALVES

A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, **NPS 2 (DN 50)** and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig (862 kPa).
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch (25 mm) and smaller.
6. Service Mark: Valves 1-1/4 inches (32 mm) to NPS 2 (DN 50) shall have initials "WOG" permanently marked on valve body.

C. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.

1. Body: Bronze, complying with ASTM B 584.
2. Ball: Chrome-plated brass.
3. Stem: Bronze; blowout proof.
4. Seats: Reinforced TFE; blowout proof.
5. Packing: Separate packnut with adjustable-stem packing threaded ends.
6. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. CWP Rating: 600 psig (4140 kPa).
8. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. Body: Bronze, complying with ASTM B 584.
2. Ball: Chrome-plated bronze.
3. Stem: Bronze; blowout proof.
4. Seats: Reinforced TFE; blowout proof.
5. Packing: Threaded-body packnut design with adjustable-stem packing.
6. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. CWP Rating: 600 psig (4140 kPa).
8. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Two-Piece, Regular-Port Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. Body: Bronze, complying with ASTM B 584.
2. Ball: Chrome-plated bronze.
3. Stem: Bronze; blowout proof.
4. Seats: Reinforced TFE.
5. Packing: Threaded-body packnut design with adjustable-stem packing.
6. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. CWP Rating: 600 psig (4140 kPa).
8. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

F. Bronze Plug Valves: MSS SP-78.

1. Body: Bronze, complying with ASTM B 584.
2. Plug: Bronze.
3. Ends: Threaded, socket, as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Operator: Square head or lug type with tamperproof feature where indicated.
5. Pressure Class: 125 psig (862 kPa).
6. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
7. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

G. PE Ball Valves: Comply with ASME B16.40.

1. Body: PE.
2. Ball: PE.
3. Stem: Acetal.
4. Seats and Seals: Nitrile.
5. Ends: Plain or fusible to match piping.
6. CWP Rating: 80 psig (552 kPa).
7. Operating Temperature: Minus 20 to plus 140 deg F (Minus 29 to plus 60 deg C).
8. Operator: Nut or flat head for key operation.
9. Include plastic valve extension.
10. Include tamperproof locking feature for valves where indicated on Drawings.

H. Valve Boxes:

1. Cast-iron, two-section box.
2. Top section with cover with "GAS" lettering.
3. Bottom section with base to fit over valve and barrel a minimum of 5 inches (125 mm) in diameter.
4. Adjustable cast-iron extensions of length required for depth of bury.
5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

2.5 MOTORIZED GAS VALVES

A. Electrically Operated Valves: Comply with UL 429.

1. Pilot operated.
2. Body: Brass or aluminum.
3. Seats and Disc: Nitrile rubber.
4. Springs and Valve Trim: Stainless steel.
5. 120-V ac, 60 Hz, Class B, continuous-duty molded coil, and replaceable.
6. NEMA ICS 6, Type 4, coil enclosure.
7. Normally closed.
8. Visual position indicator.

2.6 EARTHQUAKE VALVES

A. Earthquake Valves: Comply with ASCE 25.

1. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction.
2. Maximum Operating Pressure: 5 psig (34.5 kPa).

3. Cast-aluminum body with nickel-plated chrome steel internal parts.
4. Nitrile-rubber valve washer.
5. Sight windows for visual indication of valve position.
6. Threaded end connections complying with ASME B1.20.1.
7. Wall mounting bracket with bubble level indicator.

B. Earthquake Valves: Comply with ASCE 25.

1. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction.
2. Maximum Operating Pressure: 7 psig (48 kPa).
3. Cast-aluminum body with stainless-steel internal parts.
4. Nitrile-rubber, reset-stem o-ring seal.
5. Valve position, open or closed, indicator.
6. Composition valve seat with clapper held by spring or magnet locking mechanism.
7. Level indicator.
8. End Connections: Threaded for valves NPS 2 (DN 50) and smaller.

2.7 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 (DN 50) and smaller.

B. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Body and Diaphragm Case: Cast iron or die-cast aluminum.
2. Springs: Zinc-plated steel; interchangeable.
3. Diaphragm Plate: Zinc-plated steel.
4. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
5. Orifice: Aluminum; interchangeable.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
8. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
9. Overpressure Protection Device: Factory mounted on pressure regulator.
10. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
11. Maximum Inlet Pressure: 5 psig (34.5 kPa).

C. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Body and Diaphragm Case: Die-cast aluminum.
2. Springs: Zinc-plated steel; interchangeable.
3. Diaphragm Plate: Zinc-plated steel.
4. Seat Disc: Nitrile rubber.
5. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
6. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
7. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.

8. Maximum Inlet Pressure: 5 psig (34.5 kPa).

2.8 DIELECTRIC UNIONS

A. Dielectric Unions:

1. Description:

- a. Standard: ASSE 1079.
- b. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C).
- c. End Connections: Solder-joint copper alloy and threaded ferrous.

2.9 LABELING AND IDENTIFYING

- ### A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored yellow.

PART 3 - EXECUTION

3.1 OUTDOOR PIPING INSTALLATION

- #### A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
- #### B. Install underground, natural-gas piping buried at least 36 inches (900 mm) below finished grade. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.
1. If natural-gas piping is installed less than 36 inches (900 mm) below finished grade, install it in containment conduit.
- #### C. Install underground, PE, natural-gas piping according to ASTM D 2774.
- #### D. Steel Piping with Protective Coating:
1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
 3. Replace pipe having damaged PE coating with new pipe.
- #### E. Copper Tubing with Protective Coating:
1. Apply joint cover kits over tubing to cover, seal, and protect joints.
 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
- #### F. Install fittings for changes in direction and branch connections.

- G. Install pressure gage upstream and downstream from each service regulator. Pressure gages are specified in Section 230519 "Meters and Gages for HVAC Piping."

3.2 INDOOR PIPING INSTALLATION

- A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. 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.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Verify final equipment locations for roughing-in.
- L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches (75 mm) long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

- P. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- Q. Connect branch piping from top or side of horizontal piping.
- R. Install unions in pipes NPS 2 (DN 50) and smaller, adjacent to each valve, at final connection to each piece of equipment.
- S. Do not use natural-gas piping as grounding electrode.
- T. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- U. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in Section 230519 "Meters and Gages for HVAC Piping."
- V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.3 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing or copper connector.
- B. Install underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
- D. Install earthquake valves aboveground outside buildings according to listing.
- E. Install anode for metallic valves in underground PE piping.

3.4 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 2. Cut threads full and clean using sharp dies.
 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.

4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 5. 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.
- D. Welded Joints:
1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
 2. Bevel plain ends of steel pipe.
 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- F. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.
- G. PE 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 Pipe and Fittings: Use butt fusion.
 2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
- B. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
1. NPS 1 (DN 25) and Smaller: Maximum span, 96 inches (2438 mm); minimum rod size, 3/8 inch (10 mm).
 2. NPS 1-1/4 (DN 32): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
 3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
- D. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:
1. NPS 3/8 (DN 10): Maximum span, 48 inches (1220 mm); minimum rod size, 3/8 inch (10 mm).
 2. NPS 1/2 (DN 15): Maximum span, 72 inches (1830 mm); minimum rod size, 3/8 inch (10 mm).
 3. NPS 3/4 (DN 20) and Larger: Maximum span, 96 inches (2440 mm); minimum rod size, 3/8 inch (10 mm).

3.6 CONNECTIONS

- A. Connect to utility's gas main according to utility's procedures and requirements.
- B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within **72 inches (1800 mm)** of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.7 LABELING AND IDENTIFYING

- A. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for piping and valve identification.
- B. Install detectable warning tape directly above gas piping, **12 inches (300 mm)** below finished grade, except **6 inches (150 mm)** below subgrade under pavements and slabs.

3.8 FIELD QUALITY CONTROL

- A. Test, inspect, and purge natural gas according to the International Fuel Gas Code and authorities having jurisdiction.
- B. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.9 OUTDOOR PIPING SCHEDULE

- A. Underground natural-gas piping shall be one of the following:
 - 1. PE pipe and fittings joined by heat fusion; service-line risers with tracer wire terminated in an accessible location.
 - 2. Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
 - 3. Annealed-temper copper tube with wrought-copper fittings and brazed joints. Coat pipe and fittings with protective coating for copper tubing.
- B. Aboveground natural-gas piping shall be one of the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
 - 2. Steel pipe with wrought-steel fittings and welded joints.
 - 3. Annealed-temper copper tube with wrought-copper fittings and brazed joints.

- C. Branch Piping in Cast-in-Place Concrete to Single Appliance: Annealed-temper copper tube with wrought-copper fittings and brazed joints. Install piping embedded in concrete with no joints in concrete.
- D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.10 INDOOR PIPING SCHEDULE

- A. Aboveground, piping NPS 2 (DN 25) and smaller shall be one of the following:
 - 1. Annealed-temper copper tube with wrought-copper fittings and brazed joints.
 - 2. Steel pipe with malleable-iron fittings and threaded joints.
- B. Aboveground, piping over NPS 2 shall be the following:
 - 1. Steel pipe with wrought-steel fittings and welded joints.
- C. Underground, below building, piping shall be one of the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
 - 2. Steel pipe with wrought-steel fittings and welded joints.
- D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
- E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.11 UNDERGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Connections to Existing Gas Piping: Use valve and fitting assemblies made for tapping utility's gas mains and listed by an NRTL.
- B. Underground: PE valves.

3.12 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Valves shall be the following:
 - 1. One-piece, bronze ball valve with bronze trim.

END OF SECTION 231123

SECTION 232113

HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes pipe and fitting materials and joining methods for the following:
 - 1. Hot-water heating piping.
 - 2. Chilled-water piping.
 - 3. Condenser-water piping.
 - 4. Makeup-water piping.
 - 5. Condensate-drain piping.
 - 6. Blowdown-drain piping.
 - 7. Air-vent piping.
 - 8. Safety-valve-inlet and -outlet piping.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Plastic pipe and fittings with solvent cement.
 - 2. RTRP and RTRF with adhesive.
 - 3. Pressure-seal fittings.
 - 4. Chemical treatment.
- B. Delegated-Design Submittal:
 - 1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
 - 2. Locations of pipe anchors and alignment guides and expansion joints and loops.
 - 3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
 - 4. Locations of and details for penetration and firestopping for fire and smoke-rated wall, floor, and ceiling assemblies.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
 - 1. 125 psig (kPa) at 200 deg F (93 deg C).
 - 2. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B).
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K (ASTM B 88M, Type A).
- C. DWV Copper Tubing: ASTM B 306, Type DWV.
- D. Grooved, Mechanical-Joint, Wrought-Copper Fittings: ASME B16.22.
 - 1. Grooved-End Copper Fittings: ASTM B 75 (ASTM B 75M), copper tube or ASTM B 584, bronze casting.
 - 2. Grooved-End-Tube Couplings: Rigid pattern unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, EPDM gasket rated for minimum 230 deg F (110 deg C) for use with housing, and steel bolts and nuts.
- E. Wrought-Copper Unions: ASME B16.22.

2.3 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.
- F. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - 1. Material Group: 1.1.
 - 2. End Connections: Butt welding.
 - 3. Facings: Raised face.

G. Grooved Mechanical-Joint Fittings and Couplings:

1. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106/A 106M, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
2. Couplings: Ductile- or malleable-iron housing and EPDM gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

2.4 PLASTIC PIPE AND FITTINGS

- A. CPVC Plastic Pipe: ASTM F 441/F 441M, with wall thickness as indicated in "Piping Applications" Article.
1. CPVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM F 438 for Schedule 40 pipe; ASTM F 439 for Schedule 80 pipe.
- B. PVC Plastic Pipe: ASTM D 1785, with wall thickness as indicated in "Piping Applications" Article.
1. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.
- C. Polypropylene Pipe with faser: ASTM F 2389 or CSA B137.11
1. Approved manufacturers:
 - a. Aquatherm
 - b. Pestan

2.5 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum 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.
- 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/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- F. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

- G. Fusion welding: Comply with all manufacturer's requirements.
- H. Solvent Cements for Joining Plastic Piping:
 - 1. CPVC Piping: ASTM F 493.
 - a. CPVC solvent cement shall have a VOC content of 490 g/L or less.
 - b. Adhesive primer shall have a VOC content of 550 g/L or less.
 - c. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - a. PVC solvent cement shall have a VOC content of 510 g/L or less.
 - b. Adhesive primer shall have a VOC content of 550 g/L or less.
 - c. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- I. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.6 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings:
 - 1. One-piece fitting with one threaded brass or copper insert and one solvent-cement-joint end of material and wall thickness to match plastic pipe material.
- B. Plastic-to-Metal Transition Unions:
 - 1. Brass or copper end, solvent-cement-joint end of material and wall thickness to match plastic pipe material, rubber gasket, and threaded union.

2.7 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 - 1. Description:
 - a. Standard: ASSE 1079.
 - b. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C).
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.
 - d. Gasket: Garlock Gylon gasket

2.8 BYPASS CHEMICAL FEEDER

- A. Description: Welded steel construction; 125-psig (860-kPa) working pressure; 5-gal. (19-L) capacity; with fill funnel and inlet, outlet, and drain valves.
 - 1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Hot-water heating piping, aboveground, 3" and smaller shall be the following:
 - 1. Type L (Type B), drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
 - 2. Polypropylene pipe, fusion welded. Fire wrap piping in return plenums as necessary.
 - 3. Grooved, Mechanical-Joint, Wrought-Copper Fittings
- B. Hot-water heating piping, aboveground, larger than 3" shall be the following:
 - 1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints
 - 2. Polypropylene pipe, fusion welded. Fire wrap piping in return plenums as necessary.
- C. Hot-Water Heating Piping Installed Belowground and within Slabs: Type K (Type A), annealed-temper copper tubing, wrought-copper fittings, and brazed joints. Use the fewest possible joints.
- D. Chilled-water piping, aboveground, 3" and smaller shall be the following:
 - 1. Type L (Type B), drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
 - 2. Polypropylene pipe, fusion welded. Fire wrap piping in return plenums as necessary.
- E. Chilled-water piping, aboveground, larger than 3" shall be the following:
 - 1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints
 - 2. Polypropylene pipe, fusion welded. Fire wrap piping in return plenums as necessary.
- F. Chilled-Water Piping Installed Belowground and within Slabs: Type K (Type A), annealed-temper copper tubing, wrought-copper fittings, and brazed joints. Use the fewest possible joints.
- G. Condenser-water piping, aboveground, shall be any of the following:
 - 1. Type L (Type B), drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
 - 2. Schedule 40 steel pipe; Class 250, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
 - 3. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints
 - 4. Schedule 80 CPVC plastic pipe and fittings and solvent-welded joints.
- H. Condenser-Water Piping Installed Belowground and within Slabs: Type K (Type A), annealed-temper copper tubing, wrought-copper fittings, and brazed joints. Use the fewest possible joints.
- I. Makeup-water piping installed aboveground shall be the following:

1. **Type L (Type B)**, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
- J. Makeup-Water Piping Installed Belowground and within Slabs: **Type K (Type A)**, annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.
- K. Condensate-Drain Piping: **Type M (Type C)** Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints or Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.
- L. Condensate-Drain Piping: Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.
- M. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.
- N. Air-Vent Piping:
 1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.
 2. Outlet: **Type K (Type A)**, annealed-temper copper tubing with soldered or flared joints.
- O. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.

3.2 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, **NPS 3/4 (DN 20)** ball valve, and short **NPS 3/4 (DN 20)** threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

- N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- P. Install valves according to Section 230523.11 "Globe Valves for HVAC Piping," Section 230523.12 "Ball Valves for HVAC Piping," Section 230523.13 "Butterfly Valves for HVAC Piping," Section 230523.14 "Check Valves for HVAC Piping," and Section 230523.15 "Gate Valves for HVAC Piping."
- Q. Install unions in piping, **NPS 2 (DN 50)** and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- R. Install flanges in piping, **NPS 2-1/2 (DN 65)** and larger, at final connections of equipment and elsewhere as indicated.
- S. Install shutoff valve immediately upstream of each dielectric fitting.
- T. Comply with requirements in Section 230516 "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.
- U. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.
- V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.3 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for **NPS 2 (DN 50)** and Smaller: Use dielectric unions.
- C. Dielectric Fittings for **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Use dielectric flanges.
- D. Dielectric Fittings for **NPS 5 (DN 125)** and Larger: Use dielectric flange kits.

3.4 HANGERS AND SUPPORTS

- A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.
- B. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraints.

- C. Install the following pipe attachments:
1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet (6 m) long.
 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet (6 m) or longer.
 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
 4. Spring hangers to support vertical runs.
 5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
 6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
- D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4 (DN 20): Maximum span, 7 feet (2.1 m).
 2. NPS 1 (DN 25): Maximum span, 7 feet (2.1 m).
 3. NPS 1-1/2 (DN 40): Maximum span, 9 feet (2.7 m).
 4. NPS 2 (DN 50): Maximum span, 10 feet (3 m).
 5. NPS 2-1/2 (DN 65): Maximum span, 11 feet (3.4 m).
 6. NPS 3 (DN 80) and Larger: Maximum span, 12 feet (3.7 m).
- E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4 (DN 20): Maximum span, 5 feet (1.5 m); minimum rod size, 1/4 inch (6.4 mm).
 2. NPS 1 (DN 25): Maximum span, 6 feet (1.8 m); minimum rod size, 1/4 inch (6.4 mm).
 3. NPS 1-1/4 (DN 32): Maximum span, 7 feet (2.1 m); minimum rod size, 3/8 inch (10 mm).
 4. NPS 1-1/2 (DN 40): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
 5. NPS 2 (DN 50): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
 6. NPS 2-1/2 (DN 65): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).
 7. NPS 3 (DN 80) and Larger: Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).
- F. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
- G. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.

- E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- G. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 3. PVC Pressure Piping: Join ASTM D 1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D 2855.
 - 4. PVC Nonpressure Piping: Join according to ASTM D 2855.
- H. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.
- I. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

3.6 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Section 230519 "Meters and Gages for HVAC Piping."

3.7 CHEMICAL TREATMENT

- A. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.
- B. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.
- C. Fill systems that have antifreeze or glycol solutions with the following concentrations:
 - 1. Hot-Water Heating Piping: Minimum of 30 percent propylene glycol.

2. Chilled-Water Piping: Minimum of 30 percent propylene glycol.

3.8 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 3. Isolate expansion tanks and determine that hydronic system is full of water.
 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 6. Prepare written report of testing.
- C. Perform the following before operating the system:
 1. Open manual valves fully.
 2. Inspect pumps for proper rotation.
 3. Set makeup pressure-reducing valves for required system pressure.
 4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 5. Set temperature controls so all coils are calling for full flow.
 6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
 7. Verify lubrication of motors and bearings.

END OF SECTION 232113

SECTION 232116

HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes special-duty valves and specialties for the following:

1. Hot-water heating piping.
2. Chilled-water piping.
3. Condenser-water piping.
4. Makeup-water piping.
5. Condensate-drain piping.
6. Blowdown-drain piping.
7. Air-vent piping.
8. Safety-valve-inlet and -outlet piping.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Valves: Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
2. Air-control devices.
3. Hydronic specialties.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. ASME Compliance: Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:

1. 125 psig (kPa) at 200 deg F (93 deg C).

2. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 VALVES

- A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Section 230523.11 "Globe Valves for HVAC Piping," Section 230523.12 "Ball Valves for HVAC Piping," Section 230523.13 "Butterfly Valves for HVAC Piping," Section 230523.14 "Check Valves for HVAC Piping," and Section 230523.15 "Gate Valves for HVAC Piping."
- B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Section 230923.11 "Control Valves "Section 15901 "Control Valves."
- C. Plastic Ball Valves:
 1. Body: One-, two-, or three-piece CPVC or PVC to match piping.
 2. Ball: Full-port CPVC or PVC to match piping.
 3. Seats: PTFE.
 4. Seals: EPDM.
 5. End Connections: Socket, union, or flanged.
 6. Handle Style: Tee shape.
 7. CWP Rating: Equal to piping service.
 8. Maximum Operating Temperature: Equal to piping service.
 9. Comply with MSS SP-122.
- D. Plastic Butterfly Valves:
 1. Body: PVC or CPVC to match piping wafer type for installation between flanges.
 2. Disc: EPDM-coated steel.
 3. Seats: PTFE.
 4. Handle Style: Locking lever.
 5. CWP Rating: Equal to piping service.
 6. Maximum Operating Temperature: Equal to piping service.
- E. Plastic Check Valves:
 1. Body: One-, two-, or three-piece PVC or CPVC to match piping.
 2. Ends: Socket or flanged.
 3. Seats: PTFE.
 4. Check Style: Swing or ball type.
 5. CWP Rating: Equal to piping service.
 6. Maximum Operating Temperature: Equal to piping service.
- F. Bronze, Calibrated-Orifice, Balancing Valves:
 1. Body: Bronze, ball or plug type with calibrated orifice or venturi.
 2. Ball: Brass or stainless steel.
 3. Plug: Resin.
 4. Seat: PTFE.
 5. End Connections: Threaded or socket.
 6. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 7. Handle Style: Lever, with memory stop to retain set position.
 8. CWP Rating: Minimum 125 psig (860 kPa).

9. Maximum Operating Temperature: 250 deg F (121 deg C).

G. Diaphragm-Operated, Pressure-Reducing Valves: ASME labeled.

1. Body: Bronze or brass.
2. Disc: Glass and carbon-filled PTFE.
3. Seat: Brass.
4. Stem Seals: EPDM O-rings.
5. Diaphragm: EPT.
6. Low inlet-pressure check valve.
7. Inlet Strainer: Removable without system shutdown.
8. Valve Seat and Stem: Noncorrosive.
9. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

H. Diaphragm-Operated Safety Valves: ASME labeled.

1. Body: Bronze or brass.
2. Disc: Glass and carbon-filled PTFE.
3. Seat: Brass.
4. Stem Seals: EPDM O-rings.
5. Diaphragm: EPT.
6. Wetted, Internal Work Parts: Brass and rubber.
7. Inlet Strainer: Removable without system shutdown.
8. Valve Seat and Stem: Noncorrosive.
9. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

I. Automatic Flow-Control Valves:

1. Body: Brass or ferrous metal.
2. Piston and Spring Assembly: Stainless steel, tamper proof, self-cleaning, and removable.
3. Combination Assemblies: Include bronze or brass-alloy ball valve.
4. Identification Tag: Marked with zone identification, valve number, and flow rate.
5. Size: Same as pipe in which installed.
6. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
7. Minimum CWP Rating: 175 psig (1207 kPa).
8. Maximum Operating Temperature: 200 deg F (93 deg C).

2.3 AIR-CONTROL DEVICES

A. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2 (DN 15).
5. Discharge Connection: NPS 1/8 (DN 6).
6. CWP Rating: 150 psig (1035 kPa).
7. Maximum Operating Temperature: 225 deg F (107 deg C).

B. Expansion Tanks:

1. Tank: Welded steel, rated for 125-psig (860-kPa) working pressure and 375 deg F (191 deg C) maximum operating temperature, with taps in bottom of tank for tank fitting and taps in end of tank for gage glass. Tanks shall be factory tested after taps are fabricated and shall be labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Air-Control Tank Fitting: Cast-iron body, copper-plated tube, brass vent tube plug, and stainless-steel ball check, 100-gal. (379-L) unit only; sized for compression-tank diameter. Provide tank fittings for 125-psig (860-kPa) working pressure and 250 deg F (121 deg C) maximum operating temperature.
3. Tank Drain Fitting: Brass body, nonferrous internal parts; 125-psig (860-kPa) working pressure and 240 deg F (116 deg C) maximum operating temperature; constructed to admit air to compression tank, drain water, and close off system.
4. Gage Glass: Full height with dual manual shutoff valves, 3/4-inch- (20-mm-) diameter gage glass, and slotted-metal glass guard.

C. In-Line Air Separators:

1. Tank: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.
2. Maximum Working Pressure: Up to 175 psig (1207 kPa).
3. Maximum Operating Temperature: Up to 300 deg F (149 deg C).

2.4 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
3. Strainer Screen: Stainless-steel, 60-mesh strainer, or perforated stainless-steel basket.
4. CWP Rating: 125 psig (860 kPa).

B. Stainless-Steel Bellow, Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch (20-mm) misalignment.
4. CWP Rating: 150 psig (1035 kPa).
5. Maximum Operating Temperature: 250 deg F (121 deg C).

C. Expansion Fittings: Comply with requirements in Section 230516 "Expansion Fittings and Loops for HVAC Piping." "Section 15124 "Expansion Fittings and Loops for HVAC Piping."

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.
- B. Install calibrated-orifice, balancing valves at each branch connection to return main.
- C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.
- D. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.
- F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.2 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- C. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 (DN 50) and larger.
- D. Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.
 - 1. Install tank fittings that are shipped loose.
 - 2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.
- E. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure that tank is properly charged with air to suit system Project requirements.

END OF SECTION 232116

SECTION 232123
HYDRONIC PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Close-coupled, in-line centrifugal pumps.
2. Close-coupled, end-suction centrifugal pumps.
3. Separately coupled, horizontally mounted, in-line centrifugal pumps.
4. Separately coupled, vertically mounted, in-line centrifugal pumps.
5. Separately coupled, base-mounted, end-suction centrifugal pumps.
6. Automatic condensate pump units.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of pump.

B. Shop Drawings: For each pump.

1. Show pump layout and connections.
2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
3. Include diagrams for power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong Pumps, Inc.
2. ITT Corporation.
3. PACO Pumps; Grundfos Pumps Corporation, USA.
4. TACO Incorporated.
5. Or prior approved equal.

- B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically.
- C. Pump Construction:
1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, replaceable bronze wear rings, and threaded union-end connections.
 2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
 3. Pump Shaft: Steel, with copper-alloy shaft sleeve.
 4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and EPT bellows and gasket. Include water slinger on shaft between motor and seal.
 5. Seal: Packing seal consisting of stuffing box with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
 6. Pump Bearings: Permanently lubricated ball bearings.
- D. Motor: Single speed and rigidly mounted to pump casing.
1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - a. Enclosure: Open, drip-proof.
 - b. Enclosure Materials: Cast iron.
 - c. Motor Bearings: Permanently lubricated ball bearings.
 - d. Efficiency: Premium efficient.
- E. Capacities and Characteristics:
- a. See drawings.

2.2 CLOSE-COUPLED, END-SUCTION CENTRIFUGAL PUMPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. [Armstrong Pumps, Inc.](#)
 2. [ITT Corporation.](#)
 3. [PACO Pumps; Grundfos Pumps Corporation, USA.](#)
 4. [TACO Incorporated.](#)
 5. Or prior approved equal.
- B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally.

C. Pump Construction:

1. Casing: Radially split, cast iron, with replaceable bronze wear rings, drain plug at bottom and air vent at top of volute, threaded gage tappings at inlet and outlet, and flanged connections.
2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
3. Pump Shaft: Steel, with copper-alloy shaft sleeve or Stainless steel.
4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and EPT bellows and gasket. Include water slinger on shaft between motor and seal.
5. Pump Bearings: Permanently lubricated ball bearings.

D. Motor: Single speed and rigidly mounted to pump casing with integral pump support.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - a. Enclosure: Open, drip-proof.
 - b. Enclosure Materials: Cast iron.
 - c. Motor Bearings: Permanently lubricated ball bearings.
 - d. Efficiency: Premium efficient.

E. Capacities and Characteristics:

- a. See Drawings.

2.3 AUTOMATIC CONDENSATE PUMP UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. [Little Giant Pump Co.](#)
2. Or prior approved equal.

B. Description: Packaged units with corrosion-resistant pump, plastic tank with cover, and automatic controls. Include factory- or field-installed check valve and a **72-inch-** (1800-mm-) minimum, electrical power cord with plug.

C. Capacities and Characteristics:

- a. See drawings.

2.4 PUMP SPECIALTY FITTINGS

A. Suction Diffuser:

1. Angle pattern.
2. 175-psig (1204-kPa) pressure rating, cast-iron body and end cap, pump-inlet fitting.
3. Bronze startup and bronze or stainless-steel permanent strainers.
4. Bronze or stainless-steel straightening vanes.
5. Drain plug.
6. Factory-fabricated support.

B. Triple-Duty Valve:

1. Angle or straight pattern.
2. 175-psig (1204-kPa) pressure rating, cast-iron body, pump-discharge fitting.
3. Drain plug and bronze-fitted shutoff, balancing, and check valve features.
4. Brass gage ports with integral check valve and orifice for flow measurement.

PART 3 - EXECUTION

3.1 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- D. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.
- E. Equipment Mounting:
 1. Install base-mounted pumps on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete." [Section 033053 "Miscellaneous Cast-in-Place Concrete."
 2. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
 3. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- F. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and spring hangers with vertical-limit stop of size required to support weight of in-line pumps.
 1. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
 2. Comply with requirements for hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

3.2 ALIGNMENT

- A. Engage a factory-authorized service representative to perform alignment service.

- B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.
- C. Comply with pump and coupling manufacturers' written instructions.
- D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with non-shrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.3 CONNECTIONS

- A. Comply with requirements for piping specified in Section 232213 "Steam and Condensate Heating Piping" and Section 232216 "Steam and Condensate Piping Specialties."
- B. Drawings indicate general arrangement of piping, fittings, and specialties.
- C. Where installing piping adjacent to pump, allow space for service and maintenance.
- D. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
- E. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- F. Install check, shutoff, and throttling valves or triple-duty valve on discharge side of pumps.
- G. Install Y-type strainer and suction diffuser and shutoff valve on suction side of pumps.
- H. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.
- I. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping, or install single gage with multiple-input selector valve.
- J. Install check valve and gate or ball valve on each condensate pump unit discharge.
- K. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- L. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

END OF SECTION 232123

SECTION 232300
REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Refrigerant pipes and fittings.
 - 2. Refrigerant piping valves and specialties.
 - 3. Refrigerants.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of valve, refrigerant piping, and refrigerant piping specialty.
- B. Shop Drawings:
 - 1. Show piping size and piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
 - 2. Show interface and spatial relationships between piping and equipment.
 - 3. Shop Drawing Scale: **1/4 inch equals 1 foot (1:50)** .

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-134a:
 - 1. Suction Lines for Air-Conditioning Applications: 115 psig (793 kPa).
 - 2. Suction Lines for Heat-Pump Applications: 225 psig (1551 kPa).
 - 3. Hot-Gas and Liquid Lines: 225 psig (1551 kPa).

- B. Line Test Pressure for Refrigerant R-407C:
 - 1. Suction Lines for Air-Conditioning Applications: 230 psig (1586 kPa).
 - 2. Suction Lines for Heat-Pump Applications: 380 psig (2620 kPa).
 - 3. Hot-Gas and Liquid Lines: 380 psig (2620 kPa).

- C. Line Test Pressure for Refrigerant R-410A:
 - 1. Suction Lines for Air-Conditioning Applications: 300 psig (2068 kPa).
 - 2. Suction Lines for Heat-Pump Applications: 535 psig (3689 kPa).
 - 3. Hot-Gas and Liquid Lines: 535 psig (3689 kPa).

2.2 COPPER TUBE AND FITTINGS

- A. Copper Tube: Type L ACR hard-drawn copper pipe
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8/A5.8M.
- F. Flexible Connectors:
 - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
 - 2. End Connections: Socket ends.
 - 3. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch- (180-mm-) long assembly.
 - 4. Working Pressure Rating: Factory test at minimum 500 psig (3450 kPa).
 - 5. Maximum Operating Temperature: 250 deg F (121 deg C).

2.3 VALVES AND SPECIALTIES

- A. Diaphragm Packless Valves:
 - 1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
 - 2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.

3. Operator: Rising stem and hand wheel.
 4. Seat: Nylon.
 5. End Connections: Socket, union, or flanged.
 6. Working Pressure Rating: 500 psig (3450 kPa).
 7. Maximum Operating Temperature: 275 deg F (135 deg C).
- B. Packed-Angle Valves:
1. Body and Bonnet: Forged brass or cast bronze.
 2. Packing: Molded stem, back seating, and replaceable under pressure.
 3. Operator: Rising stem.
 4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
 5. Seal Cap: Forged-brass or valox hex cap.
 6. End Connections: Socket, union, threaded, or flanged.
 7. Working Pressure Rating: 500 psig (3450 kPa).
 8. Maximum Operating Temperature: 275 deg F (135 deg C).
- C. Check Valves:
1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
 2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
 3. Piston: Removable polytetrafluoroethylene seat.
 4. Closing Spring: Stainless steel.
 5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
 6. End Connections: Socket, union, threaded, or flanged.
 7. Maximum Opening Pressure: 0.50 psig (3.4 kPa).
 8. Working Pressure Rating: 500 psig (3450 kPa).
 9. Maximum Operating Temperature: 275 deg F (135 deg C).
- D. Service Valves:
1. Body: Forged brass with brass cap including key end to remove core.
 2. Core: Removable ball-type check valve with stainless-steel spring.
 3. Seat: Polytetrafluoroethylene.
 4. End Connections: Copper spring.
 5. Working Pressure Rating: 500 psig (3450 kPa).
- E. Solenoid Valves: Comply with AHRI 760 and UL 429; listed and labeled by a National Recognized Testing Laboratory (NRTL).
1. Body and Bonnet: Plated steel.
 2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
 3. Seat: Polytetrafluoroethylene.
 4. End Connections: Threaded.
 5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter, and 24-V ac coil.
 6. Working Pressure Rating: 400 psig (2760 kPa).
 7. Maximum Operating Temperature: 240 deg F (116 deg C).
- F. Safety Relief Valves: Comply with 2010 ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
 2. Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Seat: Polytetrafluoroethylene.
 4. End Connections: Threaded.
 5. Working Pressure Rating: 400 psig (2760 kPa).
 6. Maximum Operating Temperature: 240 deg F (116 deg C).

- G. Thermostatic Expansion Valves: Comply with AHRI 750.
1. Body, Bonnet, and Seal Cap: Forged brass or steel.
 2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Packing and Gaskets: Non-asbestos.
 4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
 5. Suction Temperature: 40 deg F (4.4 deg C).
 6. Superheat: Adjustable.
 7. Reverse-flow option (for heat-pump applications).
 8. End Connections: Socket, flare, or threaded union.
 9. Working Pressure Rating: 700 psig (4820 kPa).
- H. Hot-Gas Bypass Valves: Comply with UL 429; listed and labeled by an NRTL.
1. Body, Bonnet, and Seal Cap: Ductile iron or steel.
 2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Packing and Gaskets: Non-asbestos.
 4. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
 5. Seat: Polytetrafluoroethylene.
 6. Equalizer: Internal.
 7. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter and 24-V ac coil.
 8. End Connections: Socket.
 9. Throttling Range: Maximum 5 psig (34 kPa).
 10. Working Pressure Rating: 500 psig (3450 kPa).
 11. Maximum Operating Temperature: 240 deg F (116 deg C).
- I. Straight-Type Strainers:
1. Body: Welded steel with corrosion-resistant coating.
 2. Screen: 100-mesh stainless steel.
 3. End Connections: Socket or flare.
 4. Working Pressure Rating: 500 psig (3450 kPa).
 5. Maximum Operating Temperature: 275 deg F (135 deg C).
- J. Angle-Type Strainers:
1. Body: Forged brass or cast bronze.
 2. Drain Plug: Brass hex plug.
 3. Screen: 100-mesh monel.
 4. End Connections: Socket or flare.
 5. Working Pressure Rating: 500 psig (3450 kPa).
 6. Maximum Operating Temperature: 275 deg F (135 deg C).
- K. Moisture/Liquid Indicators:
1. Body: Forged brass.
 2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
 3. Indicator: Color coded to show moisture content in parts per million (ppm).
 4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
 5. End Connections: Socket or flare.
 6. Working Pressure Rating: 500 psig (3450 kPa).
 7. Maximum Operating Temperature: 240 deg F (116 deg C).
- L. Replaceable-Core Filter Dryers: Comply with AHRI 730.
1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
 2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.

3. Desiccant Media: Activated alumina.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: **NPS 1/4 (DN 8)** connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: **2 psig (14 kPa)** .
8. Working Pressure Rating: **500 psig (3450 kPa)**.
9. Maximum Operating Temperature: **240 deg F (116 deg C)**.

M. Permanent Filter Dryers: Comply with AHRI 730.

1. Body and Cover: Painted-steel shell.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: **NPS 1/4 (DN 8)** connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: **2 psig (14 kPa)**.
8. Working Pressure Rating: **500 psig (3450 kPa)**.
9. Maximum Operating Temperature: **240 deg F (116 deg C)**.

2.4 REFRIGERANTS

- A. ASHRAE 34, R-134a: Tetrafluoroethane.
- B. ASHRAE 34, R-407C: Difluoromethane/Pentafluoroethane/1,1,1,2-Tetrafluoroethane.
- C. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-134a

- A. Suction Lines: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.
- B. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.
- C. Safety-Relief-Valve Discharge Piping: Copper, Type **K (A)**, drawn-temper tubing and wrought-copper fittings with soldered joints.

3.2 PIPING APPLICATIONS FOR REFRIGERANT R-407C

- A. Suction Lines: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.
- B. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.

- C. Safety-Relief-Valve Discharge Piping: Copper, Type K (A), drawn-temper tubing and wrought-copper fittings with soldered joints.

3.3 PIPING APPLICATIONS FOR REFRIGERANT R-410A

- A. Suction Lines: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.
- B. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type L (B), annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
- C. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type K (A), annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
- D. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type K (A), drawn-temper tubing and wrought-copper fittings with 95-5 tin-antimony soldered joints.
- E. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type K (A), drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.
- F. Safety-Relief-Valve Discharge Piping: Copper, Type L (B), annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
- G. Safety-Relief-Valve Discharge Piping: Copper, Type K (A), annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
- H. Safety-Relief-Valve Discharge Piping: Copper, Type K (A), drawn-temper tubing and wrought-copper fittings with 95-5 tin-antimony soldered joints.
- I. Safety-Relief-Valve Discharge Piping: Copper, Type K (A), drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.

3.4 VALVE AND SPECIALTY APPLICATIONS

- A. Install diaphragm packless valves in suction and discharge lines of compressor.
- B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.
- C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
- D. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.
- E. Install a full-size, three-valve bypass around filter dryers.
- F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.
- G. Install thermostatic expansion valves as close as possible to distributors on evaporators.

1. Install valve so diaphragm case is warmer than bulb.
 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- H. Install safety relief valves where required by 2010 ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
- I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
- J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for the device being protected:
1. Solenoid valves.
 2. Thermostatic expansion valves.
 3. Hot-gas bypass valves.
 4. Compressor.
- K. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.
- L. Install receivers sized to accommodate pump-down charge.
- M. Install flexible connectors at compressors.

3.5 PIPING INSTALLATION

- A. 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 Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. 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.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.

- J. Refer to Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC" for solenoid valve controllers, control wiring, and sequence of operation.
- K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- M. Install refrigerant piping in protective conduit where installed belowground.
- N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- O. Slope refrigerant piping as follows:
 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 2. Install horizontal suction lines with a uniform slope downward to compressor.
 3. Install traps and double risers to entrain oil in vertical runs.
 4. Liquid lines may be installed level.
- P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- Q. When brazing field-installed copper refrigeration lines, use a nitrogen purge to minimize contamination of the refrigeration system during the brazing process.
- R. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- S. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."
- T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.6 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.

- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 1. Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
 - 2. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.

3.7 HANGERS AND SUPPORTS

- A. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet (6 m) long.
 - 2. Roller hangers and spring hangers for individual horizontal runs 20 feet (6 m) or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for copper tubing with the following maximum spacing and minimum rod diameters:
 - 1. NPS 1/2 (DN 15): Maximum span, 60 inches (1500 mm); minimum rod, 1/4 inch (6.4 mm).
 - 2. NPS 5/8 (DN 18): Maximum span, 60 inches (1500 mm); minimum rod, 1/4 inch (6.4 mm).
 - 3. NPS 1 (DN 25): Maximum span, 72 inches (1800 mm); minimum rod, 1/4 inch (6.4 mm).
 - 4. NPS 1-1/4 (DN 32): Maximum span, 96 inches (2400 mm); minimum rod, 3/8 inch (9.5 mm).
 - 5. NPS 1-1/2 (DN 40): Maximum span, 96 inches (2400 mm); minimum rod, 3/8 inch (9.5 mm).
 - 6. NPS 2 (DN 50): Maximum span, 96 inches (2400 mm); minimum rod, 3/8 inch (9.5 mm).
 - 7. NPS 2-1/2 (DN 65): Maximum span, 108 inches (2700 mm); minimum rod, 3/8 inch (9.5 mm).
 - 8. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod, 3/8 inch (9.5 mm).
 - 9. NPS 4 (DN 100): Maximum span, 12 feet (3.7 m); minimum rod, 1/2 inch (13 mm).
- D. Support multifloor vertical runs at least at each floor.

3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Comply with ASME B31.5, Chapter VI.

2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.
- B. Prepare test and inspection reports.

3.9 SYSTEM CHARGING

- A. Charge system using the following procedures:
1. Install core in filter dryers after leak test but before evacuation.
 2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers (67 Pa). If vacuum holds for 12 hours, system is ready for charging.
 3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig (14 kPa).
 4. Charge system with a new filter-dryer core in charging line.

3.10 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
1. Open shutoff valves in condenser water circuit.
 2. Verify that compressor oil level is correct.
 3. Open compressor suction and discharge valves.
 4. Open refrigerant valves except bypass valves that are used for other purposes.
 5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

SECTION 232513

WATER TREATMENT FOR CLOSED-LOOP HYDRONIC SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes the following water treatment for closed-loop hydronic systems:
 1. Automatic chemical-feed equipment.
 2. Chemicals.

1.2 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, and furnished specialties and accessories for each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Approved chemical treatment contractors are powers engineering and W.E.S.T. INC.

2.2 PERFORMANCE REQUIREMENTS

- A. Closed hydronic systems shall have the following water qualities:
 1. pH: Maintain a value within 9.0 to 10.5.
 2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
 3. Boron: Maintain a value within 100 to 200 ppm.
 4. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
 5. Soluble Copper: Maintain a maximum value of 0.20 ppm.

6. TSS: Maintain a maximum value of 10 ppm.
7. Ammonia: Maintain a maximum value of 20 ppm.
8. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.
9. Microbiological Limits:
 - a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/mL.
 - b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/mL.
 - c. Nitrate Reducers: Maintain a maximum value of 100 organisms/mL.
 - d. Sulfate Reducers: Maintain a maximum value of zero organisms/mL.
 - e. Iron Bacteria: Maintain a maximum value of zero organisms/mL.

2.3 AUTOMATIC CHEMICAL-FEED EQUIPMENT

A. Water Meter:

1. AWWA C700, oscillating-piston, magnetic-drive, totalization meter.
2. Body: Bronze.
3. Minimum Working-Pressure Rating: 150 psig (1035 kPa).
4. Maximum Pressure Loss at Design Flow: 3 psig (20 kPa).
5. Registration: Gallons (Liters) or cubic feet (cubic meters).
6. End Connections: Threaded.
7. Controls: Flow-control switch with normally open contacts; rated for maximum 10 A, 250-V ac; and that will close at adjustable increments of total flow.
8. 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. Chemical Solution Tanks:

1. Chemical-resistant reservoirs fabricated from high-density opaque polyethylene with minimum 110 percent containment vessel.
2. Molded cover with recess for mounting pump.
3. Capacity: 50 gal. (189 L).

C. Chemical Solution Injection Pumps:

1. Self-priming, positive displacement; rated for intended chemical with minimum 25 percent safety factor for design pressure and temperature.
2. Adjustable flow rate.
3. Metal and thermoplastic construction.
4. Built-in relief valve.
5. Fully enclosed, continuous-duty, single-phase motor. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
6. 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.

D. Chemical Solution Tubing: Polyethylene tubing with compression fittings and joints except ASTM A 269, Type 304, stainless steel for steam boiler injection assemblies.

E. Injection Assembly:

1. Quill: Minimum **NPS 1/2 (DN 15)** with insertion length sufficient to discharge into at least 25 percent of pipe diameter.
2. Ball Valve: Three-piece, stainless steel; selected to fit quill.
3. Packing Gland: Mechanical seal on quill of sufficient length to allow quill removal during system operation.
4. Assembly Pressure/Temperature Rating: Minimum **600 psig (4137 kPa)** at **200 deg F (93 deg C)**.

2.4 CHEMICALS

- A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment and that can attain water quality specified in "Performance Requirements" Article.

PART 3 - EXECUTION

3.1 WATER ANALYSIS

- A. Perform an analysis of supply water to determine quality of water available at Project site.

3.2 INSTALLATION

- A. Install chemical application equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.
- B. Install seismic restraints for equipment and floor-mounting accessories and anchor to building structure. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraints.
- C. Install water testing equipment on wall near water chemical application equipment.
- D. Install interconnecting control wiring for chemical treatment controls and sensors.
- E. Mount sensors and injectors in piping circuits.
- F. Bypass Feeders: Install in closed hydronic systems, including hot-water heating, and equipped with the following:
 1. Install bypass feeder in a bypass circuit around circulating pumps unless otherwise indicated on Drawings.
 2. Install water meter in makeup-water supply.
 3. Install test-coupon assembly in bypass circuit around circulating pumps unless otherwise indicated on Drawings.
 4. Install a gate or full-port ball isolation valves on inlet, outlet, and drain below the feeder inlet.
 5. Install a swing check on the inlet after the isolation valve.
- G. Where installing piping adjacent to equipment, allow space for service and maintenance.

- H. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Comply with requirements in Section 232116 "Hydronic Piping Specialties"
- I. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified in Section 230523.11 "Globe Valves for HVAC Piping," Section 230523.12 "Ball Valves for HVAC Piping," Section 230523.13 "Butterfly Valves for HVAC Piping," and Section 230523.15 "Gate Valves for HVAC Piping."
- J. Comply with requirements in Section 221119 "Domestic Water Piping Specialties" for backflow preventers required in makeup-water connections to potable-water systems.
- K. Confirm applicable electrical requirements in electrical Sections for connecting electrical equipment.
- L. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- M. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Include one year of onsite service including chemical.
- B. Perform the following tests and inspections:
 1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
 2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
 3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of hydronic systems' startup procedures.
 4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
 5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
 7. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
 8. Repair leaks and defects with new materials and retest piping until no leaks exist.
- C. Equipment will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 232513

SECTION 233113

METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Single-wall rectangular ducts and fittings.
 - 2. Single-wall round ducts and fittings.
 - 3. Sheet metal materials.
 - 4. Duct liner.
 - 5. Sealants and gaskets.
 - 6. Hangers and supports.
 - 7. Seismic-restraint devices.
- B. Related Sections:
 - 1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
 - 2. Section 233300 "Air Duct Accessories" for dampers, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
 - 1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
 - 2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
 - 3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.
- B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 QUALITY ASSURANCE

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 GENERAL

- A. HVAC Duct shall be fabricated from galvanized steel in accordance with SMACNA requirements. Abrasive, corrosive, or hazardous materials shall be conveyed by systems described in Industrial Ventilation, latest edition, in harmony with the Fume Hood Section of these Design Standards. Nonmetallic duct shall not be used.
- B. All seams of ducts shall be sealed with mastic or mastic plus tape or gasketing as appropriate to limit the air leakage to SMACNA requirements.
- C. Flexible ductwork shall only be used at terminal units and shall not exceed eight feet. Hard turns, offsets, or kinks will not be allowed. Provide duct supports every three feet.
- D. High pressure ductwork shall be galvanized steel spiral lockseam construction.
- E. The high pressure duct and fittings shall be manufactured by the same firm.
- F. High pressure ductwork shall be tested and total allowable leakage of the system shall not exceed SMACNA requirements.

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS – SEAL CLASS A

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 1. [Manufacturers](#): Subject to compliance with requirements, provide products by one of the following:
 - a. [Lindab Inc.](#)

- b. [McGill AirFlow LLC.](#)
- c. [SEMCO Incorporated.](#)
- d. [Sheet Metal Connectors, Inc.](#)
- e. [Spiral Manufacturing Co., Inc.](#)

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- 1. Transverse Joints in Ducts Larger Than **60 Inches (1524 mm)** in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- 1. Fabricate round ducts larger than **90 inches (2286 mm)** in diameter with butt-welded longitudinal seams.
- 2. Fabricate flat-oval ducts larger than **72 inches (1830 mm)** in width (major dimension) with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. [Linx Industries \(formerly Lindab\).](#)
- 2. [McGill AirFlow LLC.](#)
- 3. [MKT Metal Manufacturing.](#)
- 4. [SEMCO LLC.](#)
- 5. [Sheet Metal Connectors, Inc.](#)

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.

- 1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- a. Transverse Joints in Ducts Larger Than **60 Inches (1524 mm)** in Diameter: Flanged.

2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - a. Fabricate round ducts larger than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.
 - b. Fabricate flat-oval ducts larger than 72 inches (1830 mm) in width (major dimension) with butt-welded longitudinal seams.
3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Inner Duct: Minimum 0.028-inch (0.7-mm) perforated galvanized sheet steel having 3/32-inch (2.4-mm-) diameter perforations, with overall open area of 23 percent.
- E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K) at 75 deg F (24 deg C) mean temperature.
 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 3. Coat insulation with antimicrobial coating.
 4. Cover insulation with polyester film complying with UL 181, Class 1.
- F. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
 1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F (0.034 W/m x K) at 75 deg F (24 deg C) mean temperature.

2.5 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 1. Galvanized Coating Designation: G60 (Z180).
 2. Finishes for Surfaces Exposed to View: Mill phosphatized.

2.6 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 3 inches (76 mm).
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
11. VOC: Maximum 395 g/L.
12. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive or negative.
13. Service: Indoor or outdoor.
14. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m at 250 Pa) and shall be rated for 10-inch wg (2500-Pa) static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.7 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

- B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," [Table 5-1 \(Table 5-1M\)](#), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- F. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.8 SEISMIC-RESTRAINT DEVICES

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - 1. [Cooper B-Line, Inc.; a division of Cooper Industries.](#)
 - 2. [Ductmate Industries, Inc.](#)
 - 3. [Hilti Corp.](#)
 - 4. [Kinetics Noise Control.](#)
 - 5. [Loos & Co.; Cableware Division.](#)
 - 6. [Mason Industries.](#)
 - 7. [TOLCO; a brand of NIBCO INC.](#)
 - 8. [Unistrut Corporation; Tyco International, Ltd..](#)
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.
- D. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.
- E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of **1 inch (25 mm)**, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least **1-1/2 inches (38 mm)**.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.
- F. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 2. Conditioned Space, Supply-Air Ducts in Pressure Classes **2-Inch wg (500 Pa)** and Lower: Seal Class A.
 3. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than **2-Inch wg (500 Pa)**: Seal Class A.
 4. Conditioned Space, Exhaust Ducts: Seal Class A
 5. Conditioned Space, Return-Air Ducts: Seal Class A.

3.3 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 2. Outdoor, Supply-Air Ducts: Seal Class A.
 3. Outdoor, Exhaust Ducts: Seal Class C.
 4. Outdoor, Return-Air Ducts: Seal Class C.
 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes **2-Inch wg (500 Pa)** and Lower: Seal Class B.
 6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than **2-Inch wg (500 Pa)**: Seal Class A.
 7. Unconditioned Space, Exhaust Ducts: Seal Class C.
 8. Unconditioned Space, Return-Air Ducts: Seal Class B.
 9. Conditioned Space, Supply-Air Ducts in Pressure Classes **2-Inch wg (500 Pa)** and Lower: Seal Class C.
 10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than **2-Inch wg (500 Pa)**: Seal Class B.
 11. Conditioned Space, Exhaust Ducts: Seal Class B.
 12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 1. Where practical, install concrete inserts before placing concrete.
 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than **4 inches (100 mm)** thick.
 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than **4 inches (100 mm)** thick.

- 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (5 m).
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
 - 1. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.
 - 2. Brace a change of direction longer than 12 feet (3.7 m).
- B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install cable restraints on ducts that are suspended with vibration isolators.
- E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.
- G. Drilling for and Setting Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-stressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.6 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
 - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
 - 2. Test the following systems:
 - a. Ducts with a Pressure Class Higher Than **3-Inch wg (750 Pa)**: Test representative duct sections totaling no less than 100 percent of total installed duct area for each designated pressure class.
 - b. Supply Ducts with a Pressure Class of **2-Inch wg (500 Pa)** or Higher: Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.
 - c. Return Ducts with a Pressure Class of **2-Inch wg (500 Pa)** or Higher: Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.
 - d. Exhaust Ducts with a Pressure Class of **2-Inch wg (500 Pa)** or Higher: Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.
 - e. Outdoor Air Ducts with a Pressure Class of **2-Inch wg (500 Pa)** or Higher: Test representative duct sections totaling no less than 100 percent of total installed duct area for each designated pressure class.
 - 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 - 4. Test for leaks before applying external insulation.
 - 5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
 - 6. Give seven days' advance notice for testing.
- C. Duct System Cleanliness Tests:
 - 1. Visually inspect duct system to ensure that no visible contaminants are present.
 - 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
- D. Duct system will be considered defective if it does not pass tests and inspections.

- E. Prepare test and inspection reports.

3.8 DUCT CLEANING

- A. Clean new and existing duct system(s) before testing, adjusting, and balancing.

- B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

- C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

- D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

- E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.

7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.9 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner or any ductwork noted on mechanical plans that require painting. Apply one coat of flat, latex paint over a compatible galvanized-steel primer.

3.10 START UP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

3.12 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Underground Ducts: Concrete-encased, PVC-coated, galvanized sheet steel with thicker coating on duct exterior or pre-insulated high-density polyethylene.

- B. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

- a. Pressure Class: Positive **1-inch wg (250 Pa)**.
- b. Minimum SMACNA Seal Class: C.
- c. SMACNA Leakage Class for Rectangular: 24.
- d. SMACNA Leakage Class for Round and Flat Oval: 24.

2. Ducts Connected to Constant-Volume Air-Handling Units:

- a. Pressure Class: Positive **2-inch wg (500 Pa)**.
- b. Minimum SMACNA Seal Class: B.
- c. SMACNA Leakage Class for Rectangular: 12.
- d. SMACNA Leakage Class for Round and Flat Oval: 12.

3. Ducts Connected to Variable-Air-Volume Air-Handling Units:

- a. Pressure Class: Positive **4-inch wg (1000 Pa)**.
- b. Minimum SMACNA Seal Class: A.
- c. SMACNA Leakage Class for Rectangular: 6.
- d. SMACNA Leakage Class for Round and Flat Oval: 3.

- C. Return Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

- a. Pressure Class: Positive **1-inch wg (250 Pa)**.
- b. Minimum SMACNA Seal Class: C.

- c. SMACNA Leakage Class for Rectangular: 24.
 - d. SMACNA Leakage Class for Round and Flat Oval: 24.
2. Ducts Connected to Air-Handling Units:
- a. Pressure Class: Positive or negative 3-inch wg (750 Pa).
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 6.
- D. Exhaust Ducts:
1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
- a. Pressure Class: Negative 3-inch wg (750 Pa).
 - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round and Flat Oval: 6.
2. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.
- a. Exposed to View: Type 304, stainless-steel sheet, No. 4 finish.
 - b. Concealed: Type 304, welded black iron.
 - c. Welded seams and joints.
 - d. Pressure Class: Positive or negative 2-inch wg (500 Pa).
 - e. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - f. SMACNA Leakage Class: 3.
3. Ducts Connected to Dishwasher Hoods:
- a. Type 304, stainless-steel sheet.
 - b. Exposed to View: No. 4 finish.
 - c. Concealed: No. 2D finish.
 - d. Welded seams and flanged joints with watertight EPDM gaskets.
 - e. Pressure Class: Positive or negative 2-inch wg (500 Pa).
 - f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - g. SMACNA Leakage Class: 3.
4. Ducts Connected to Fans Exhausting Laboratory and Process (ASHRAE 62.1, Class 3 and 4) Air:
- a. Type 316, stainless-steel sheet.
 - 1) Exposed to View: No. 4 finish.
 - 2) Concealed: No. 2B finish.
 - b. PVC-coated, galvanized sheet steel with thicker coating on duct interior.
 - c. Pressure Class: Positive or negative 4-inch wg (1000 Pa).
 - d. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - e. SMACNA Leakage Class: 3.
- E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

- a. Pressure Class: Positive 1-inch wg (250 Pa).
 - b. Minimum SMACNA Seal Class: C.
 - c. SMACNA Leakage Class for Rectangular: 24.
 - d. SMACNA Leakage Class for Round and Flat Oval: 24.
2. Ducts Connected to Air-Handling Units:
- a. Pressure Class: Positive or negative 3-inch wg (750 Pa).
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 6.
- F. Intermediate Reinforcement:
- 1. Galvanized-Steel Ducts: Galvanized steel.
- G. Liner:
- 1. Supply Air Ducts: Fibrous glass, Type I, 1 inch (25 mm) thick.
- H. Double-Wall Duct Interstitial Insulation:
- 1. Supply Air Ducts: 1 inch (25 mm) thick.
 - 2. Acoustical Performance:
 - a. NRC: 1.09 according to ASTM C 423.
 - b. STC: 40 according to ASTM E 90.
- I. Elbow Configuration:
- 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm (5 m/s) or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
 - b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s):
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - c. Velocity 1500 fpm (7.6 m/s) or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - 2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c.
 - 3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

- 1) Velocity 1000 fpm (5 m/s) or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm (5 to 7.6 m/s): 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm (7.6 m/s) or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 4) Radius-to Diameter Ratio: 1.5.
- b. Round Elbows, 12 Inches (305 mm) and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches (356 mm) and Larger in Diameter.

J. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm (5 m/s) or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap.
 - c. Velocity 1500 fpm (7.6 m/s) or Higher: 45-degree lateral.

END OF SECTION 233113

BLANK PAGE

SECTION 233300

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Manual volume dampers.
 - 2. Control dampers.
 - 3. Turning vanes.
 - 4. Remote damper operators.
 - 5. Duct-mounted access doors.
 - 6. Flexible connectors.
 - 7. Flexible ducts.
 - 8. Duct accessory hardware.
 - 9. Louvers

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: **G60 (Z180)**.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2.
- C. Aluminum Sheets: Comply with **ASTM B 209 (ASTM B 209M)**, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

- D. Extruded Aluminum: Comply with [ASTM B 221 \(ASTM B 221M\)](#), Alloy 6063, Temper T6.
- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- F. Tie Rods: Galvanized steel, [1/4-inch \(6-mm\)](#) minimum diameter for lengths [36 inches \(900 mm\)](#) or less; [3/8-inch \(10-mm\)](#) minimum diameter for lengths longer than [36 inches \(900 mm\)](#).

2.3 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Air Balance Inc.; a division of Mestek, Inc.](#)
 - b. [American Warming and Ventilating; a division of Mestek, Inc.](#)
 - c. [Flexmaster U.S.A., Inc.](#)
 - d. [McGill AirFlow LLC.](#)
 - e. [Nailor Industries Inc.](#)
 - f. [Pottorff.](#)
 - g. [Ruskin Company.](#)
 - h. [Trox USA Inc.](#)
 - i. [Vent Products Company, Inc.](#)
 2. Standard leakage rating
 3. Suitable for horizontal or vertical applications.
 4. Frames:
 - a. Frame: Hat-shaped, [0.094-inch- \(2.4-mm-\)](#) thick, galvanized sheet steel.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized-steel, [0.064 inch \(1.62 mm\)](#) thick.
 6. Blade Axles: Galvanized steel.
 7. Bearings:
 - a. Oil-impregnated bronze.
 - b. Dampers in ducts with pressure classes of [3-inch wg \(750 Pa\)](#) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 8. Tie Bars and Brackets: Galvanized steel.

2.4 CONTROL DAMPERS

- A. [Basis-of-Design Product](#): Subject to compliance with requirements, provide or comparable product by one of the following:
 1. [American Warming and Ventilating; a division of Mestek, Inc.](#)
 2. [Arrow United Industries; a division of Mestek, Inc.](#)
 3. [Cesco Products; a division of Mestek, Inc.](#)
 4. [Greenheck Fan Corporation.](#)
 5. [Lloyd Industries, Inc.](#)
 6. [McGill AirFlow LLC.](#)
 7. [Metal Form Manufacturing, Inc.](#)
 8. [Nailor Industries Inc.](#)
 9. [NCA Manufacturing, Inc.](#)
 10. [Pottorff.](#)
 11. [Ruskin Company.](#)

12. [Vent Products Company, Inc.](#)
13. [Young Regulator Company.](#)

- B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
- C. Frames:
1. Hat shaped.
 2. **0.094-inch- (2.4-mm-)** thick, galvanized sheet steel.
 3. Mitered and welded corners.
- D. Blades:
1. Multiple blade with maximum blade width of **6 inches (152 mm)**.
 2. Opposed-blade design.
 3. Galvanized-steel.
 4. **0.064 inch (1.62 mm)** thick single skin.
 5. Blade Edging: Closed-cell neoprene.
 6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.
- E. Blade Axles: **1/2-inch- (13-mm-)** diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
1. Operating Temperature Range: From **minus 40 to plus 200 deg F (minus 40 to plus 93 deg C)**.
- F. Bearings:
1. Oil-impregnated bronze.
 2. Dampers in ducts with pressure classes of **3-inch wg (750 Pa)** or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 3. Thrust bearings at each end of every blade.

2.5 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. [Ductmate Industries, Inc.](#)
 2. [Duro Dyne Inc.](#)
 3. [Elgen Manufacturing.](#)
 4. [METALAIRE, Inc.](#)
 5. [SEMCO Incorporated.](#)
 6. [Ward Industries, Inc.; a division of Hart & Cooley, Inc.](#)
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."
- D. Vane Construction: Single wall.
- E. Vane Construction: Single wall for ducts up to **48 inches (1200 mm)** wide and double wall for larger dimensions.

2.6 REMOTE DAMPER OPERATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. [Pottorff](#).
 - 2. [Ventfabrics, Inc.](#)
 - 3. [Young Regulator Company..](#)
- B. Description: Cable system designed for remote manual damper adjustment.
- C. Tubing: Brass.
- D. Cable: Stainless steel.
- E. Wall-Box Mounting: Recessed.
- F. Wall-Box Cover-Plate Material: Steel.

2.7 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. [American Warming and Ventilating; a division of Mestek, Inc.](#)
 - 2. [Cesco Products; a division of Mestek, Inc.](#)
 - 3. [Ductmate Industries, Inc.](#)
 - 4. [Elgen Manufacturing.](#)
 - 5. [Flexmaster U.S.A., Inc.](#)
 - 6. [Greenheck Fan Corporation.](#)
 - 7. [McGill AirFlow LLC.](#)
 - 8. [Nailor Industries Inc.](#)
 - 9. [Pottorff.](#)
 - 10. [Ventfabrics, Inc.](#)
 - 11. [Ward Industries, Inc.; a division of Hart & Cooley, Inc.](#)
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2 (7-2M), "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
 - 1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Vision panel.
 - d. Hinges and Latches: **1-by-1-inch (25-by-25-mm)**butt or piano hinge and cam latches.
 - e. Fabricate doors airtight and suitable for duct pressure class.
 - 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 - 3. Number of Hinges and Locks:
 - a. Access Doors Less Than **12 Inches (300 mm)** Square: No hinges and two sash locks.
 - b. Access Doors up to **18 Inches (460 mm)** Square: Continuous and two sash locks.
 - c. Access Doors up to **24 by 48 Inches (600 by 1200 mm)**: Continuous and two compression latches with outside and inside handles.
 - d. Access Doors Larger Than **24 by 48 Inches (600 by 1200 mm)**: Continuous and two compression latches with outside and inside handles.

2.8 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. [Ductmate Industries, Inc.](#)
 2. [Duro Dyne Inc.](#)
 3. [Elgen Manufacturing.](#)
 4. [Ventfabrics, Inc.](#)
 5. [Ward Industries, Inc.; a division of Hart & Cooley, Inc.](#)
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip **3-1/2 inches (89 mm)** wide attached to two strips of **2-3/4-inch- (70-mm-)** wide, **0.028-inch- (0.7-mm-)** thick, galvanized sheet steel or **0.032-inch- (0.8-mm-)** thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
1. Minimum Weight: **26 oz./sq. yd. (880 g/sq. m).**
 2. Tensile Strength: **480 lbf/inch (84 N/mm)** in the warp and **360 lbf/inch (63 N/mm)** in the filling.
 3. Service Temperature: **Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).**

2.9 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. [Flexmaster U.S.A., Inc.](#)
 2. [McGill AirFlow LLC.](#)
 3. [Ward Industries, Inc.; a division of Hart & Cooley, Inc.](#)
- B. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
1. Pressure Rating: **4-inch wg (1000 Pa)** positive and **0.5-inch wg (125 Pa)** negative.
 2. Maximum Air Velocity: **4000 fpm (20 m/s).**
 3. Temperature Range: **Minus 20 to plus 175 deg F (Minus 29 to plus 79 deg C).**
 4. Insulation R-Value: Comply with ASHRAE/IESNA 90.1.
- C. Flexible Duct Connectors:
1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes **3 through 18 inches (75 through 460 mm)**, to suit duct size.
 2. Non-Clamp Connectors: Adhesive plus sheet metal screws.

2.10 LOUVERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ruskin Company
 2. Greenheck Fan Corporation
 3. Pottorff
- B. Fabrication: Hidden support style.
1. Frame:
 - a. Frame Depth: 6 inches .

- b. Material: Extruded aluminum, Alloy 6063-T5.
- c. Wall Thickness: 0.125 inch, nominal.
- 2. Blades:
 - a. Style: Drainable.
 - b. Material: Formed aluminum, Alloy 6063-T5.
 - c. Wall Thickness: 0.081 inch, nominal.
 - d. Angle: 37-1/2 degrees.
 - e. Centers: 4 inches, nominal.
- 3. Gutters: Drain gutter in head frame and each blade.
- 4. Downspouts: Downspouts in jambs to drain water from louver for minimum water cascade from blade to blade.
- 5. Fabrication:
 - a. Mullion/Hidden Intermediate Support Style – Design incorporates visible mullions or frames at the perimeter of the louver and at section joints only. Rear-mounted hidden blade supports are utilized where required and do not interrupt the louver blade sightlines. The rear-mounted blade support depth varies depending on louver height and the design windload.
- 6. Assembly:
 - a. Factory assembled louver components. Mechanically fastened construction.

C. Performance Data:

- 1. Performance Ratings: AMCA licensed.
 - a. Based on testing 48 inch by 48 inch size unit in accordance with AMCA 500.
- 2. Free Area: 58 percent, nominal.
- 3. Maximum Recommended Air Flow through Free Area: 1250 feet per minute.
- 4. Air Flow: 11,600 cubic feet per minute.
- 5. Maximum Pressure Drop (Intake): 0.20 inches w.g. .
- 6. Water Penetration: Maximum of 0.01 ounces per square foot of free area at an air flow of 1250 feet per minute free area velocity when tested for 15 minutes.

D. Bird Screen:

- 1. Aluminum: Aluminum, 1/4 inch x 1/4 inch.
- 2. Frame: Removable, re-wireable.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
- D. Set dampers to fully open position before testing, adjusting, and balancing.
- E. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

- F. Install access doors with swing against duct static pressure.
- G. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).
 - 2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).
 - 3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
 - 4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).
 - 5. Body Access: 25 by 14 inches (635 by 355 mm).
 - 6. Body plus Ladder Access: 25 by 17 inches (635 by 430 mm).
- H. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- I. Install flexible connectors to connect ducts to equipment.
- J. For fans developing static pressures of 5-inch wg (1250 Pa) and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- K. Connect terminal units to supply ducts with maximum 12-inch (300-mm) lengths of flexible duct. Do not use flexible ducts to change directions.
- L. Connect diffusers or light troffer boots to ducts in-directly with maximum 36-inch (900-mm) lengths of flexible duct clamped or strapped in place. Do not use flexible ducts to change directions.
- M. Connect flexible ducts to metal ducts with liquid adhesive plus clamp-type draw bands.
- N. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch (6-mm) movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 - 3. Inspect turning vanes for proper and secure installation.
 - 4. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 233423

HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Centrifugal roof ventilators.
2. Centrifugal wall ventilators.
3. Ceiling-mounted ventilators.
4. In-line centrifugal fans.
5. Propeller fans.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.
3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
4. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Broan-NuTone LLC.
 2. Carnes Company.
 3. Greenheck Fan Corporation.
 4. Loren Cook Company.
 5. PennBarry.
- B. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.
 2. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.
- C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- D. Belt Drives:
1. Resiliently mounted to housing.
 2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 4. Pulleys: Cast-iron, adjustable-pitch motor pulley.
 5. Fan and motor isolated from exhaust airstream.
- E. Accessories:
1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
 2. Disconnect Switch: Non-fusible type, with thermal-overload protection mounted outside fan housing, factory wired through an internal aluminum conduit.
 3. Bird Screens: Removable, **1/2-inch (13-mm)** mesh, aluminum or brass wire.
 4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
 5. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.
- F. Roof Curbs: Galvanized steel; mitered and welded corners; **1-1/2-inch- (40-mm-)** thick, rigid, fiberglass insulation adhered to inside walls; and **1-1/2-inch (40-mm)** wood nailer. Size as required to suit roof opening and fan base.
1. Configuration: Built-in raised cant and mounting flange.
 2. Overall Height: **14 inches.**
 3. Sound Curb: Curb with sound-absorbing insulation.
 4. Pitch Mounting: Manufacture curb for roof slope.
 5. Metal Liner: Galvanized steel.

6. Burglar Bars: **1/2-inch- (13-mm-)** thick steel bars welded in place to form **6-inch (150-mm)** squares.
7. Mounting Pedestal: Galvanized steel with removable access panel.
8. Vented Curb: Unlined with louvered vents in vertical sides.

- G. Capacities and Characteristics:
a. See Drawings

2.2 CENTRIFUGAL WALL VENTILATORS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

1. [Acme Engineering & Manufacturing Corp.](#)
2. [Broan-NuTone LLC.](#)
3. [Carnes Company.](#)
4. [Greenheck Fan Corporation.](#)
5. [Loren Cook Company.](#)
6. [PennBarry.](#)

- B. Housing: Heavy-gage, removable, spun-aluminum, dome top and outlet baffle; venturi inlet cone.

- C. Fan Wheel: Aluminum hub and wheel with backward-inclined blades.

- D. Belt Drives:

1. Resiliently mounted to housing.
2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
4. Pulleys: Cast-iron, adjustable-pitch motor pulley.
5. Fan and motor isolated from exhaust airstream.

- E. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Disconnect Switch: Non-fusible type, with thermal-overload protection mounted inside fan housing, factory wired through internal aluminum conduit.
3. Bird Screens: Removable, **1/2-inch (13-mm)** mesh, aluminum or brass wire.
4. Wall Grille: Ring type for flush mounting.
5. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in wall sleeve; factory set to close when fan stops.
6. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.

- F. Capacities and Characteristics:
a. See Drawings

2.3 CEILING-MOUNTED VENTILATORS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
1. [Broan-NuTone LLC.](#)
 2. [Carnes Company.](#)
 3. [Greenheck Fan Corporation.](#)
 4. [Loren Cook Company.](#)
 5. [PennBarry.](#)
- B. Housing: Steel, lined with acoustical insulation.
- C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.
- D. Grille: Aluminum, louvered grille with flange on intake and thumbscrew attachment to fan housing.
- E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.
- F. Accessories:
1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
 2. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
 3. Time-Delay Switch: Assembly with single-pole rocker switch, timer, and cover plate.
 4. Motion Sensor: Motion detector with adjustable shutoff timer.
 5. Ceiling Radiation Damper: Fire-rated assembly with ceramic blanket, stainless-steel springs, and fusible link.
 6. Filter: Washable aluminum to fit between fan and grille.
 7. Isolation: Rubber-in-shear vibration isolators.
 8. Manufacturer's standard roof jack or wall cap, and transition fittings.
- G. Capacities and Characteristics:
- a. See Drawings

2.4 IN-LINE CENTRIFUGAL FANS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
1. [Carnes Company.](#)
 2. [Greenheck Fan Corporation.](#)
 3. [Loren Cook Company.](#)
 4. [PennBarry.](#)
- B. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.
- C. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing; with wheel, inlet cone, and motor on swing-out service door.

- D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.
- E. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.
- F. Accessories:
 - 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
 - 2. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
 - 3. Companion Flanges: For inlet and outlet duct connections.
 - 4. Fan Guards: **1/2- by 1-inch (13- by 25-mm)** mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
 - 5. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.
- G. Capacities and Characteristics:
 - 1. See drawings.

2.5 PROPELLER FANS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - 1. [Broan-NuTone LLC.](#)
 - 2. [Carnes Company.](#)
 - 3. [Loren Cook Company.](#)
 - 4. [PennBarry.](#)
- B. Housing: Galvanized-steel sheet with flanged edges and integral orifice ring with baked-enamel finish coat applied after assembly.
- C. Steel Fan Wheels: Formed-steel blades riveted to heavy-gage steel spider bolted to cast-iron hub.
- D. Fan Wheel: Replaceable, extruded-aluminum, airfoil blades fastened to cast-aluminum hub; factory set pitch angle of blades.
- E. Fan Drive: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.
- F. Fan Drive:
 - 1. Resiliently mounted to housing.
 - 2. Statically and dynamically balanced.
 - 3. Selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
 - 4. Extend grease fitting to accessible location outside of unit.
 - 5. Service Factor Based on Fan Motor Size: 1.4.
 - 6. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 - 7. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.

- a. Ball-Bearing Rating Life: ABMA 9, L_{10} of 100,000 hours.
 8. Pulleys: Cast iron with split, tapered bushing; dynamically balanced at factory.
 9. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
 10. Belts: Oil resistant, non-sparking, and non-static; matched sets for multiple belt drives.
 11. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.
- G. Accessories:
1. Gravity Shutters: Aluminum blades in aluminum frame; interlocked blades with nylon bearings.
 2. Motor-Side Back Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.
 3. Wall Sleeve: Galvanized steel to match fan and accessory size.
 4. Weathershield Hood: Galvanized steel to match fan and accessory size.
 5. Weathershield Front Guard: Galvanized steel with expanded metal screen.
 6. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
 7. Disconnect Switch: Non-fusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
- H. Capacities and Characteristics:
1. See Drawings.

2.6 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- B. Enclosure Type: Totally enclosed, fan cooled.

2.7 SOURCE QUALITY CONTROL

- A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment Mounting:

1. Install power ventilators on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete".
2. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
3. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

B. Secure roof-mounted fans to roof curbs with cadmium-plated hardware. See Section 077200 "Roof Accessories" for installation of roof curbs.

C. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

D. Support suspended units from structure using threaded steel rods and spring hangers with vertical-limit stops having a static deflection of 1 inch (25 mm). Vibration-control devices are specified in Section 230548 "Vibration and Seismic Controls for HVAC." Section 230548.13 "Vibration Controls for HVAC."

E. Install units with clearances for service and maintenance.

F. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

END OF SECTION 233423

SECTION 233439 - HIGH-VOLUME, LOW-SPEED FANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes high-volume, low-speed fans.

1.3 DEFINITIONS

- A. HVLS - High volume, low speed.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, furnished specialties, and accessories for each fan.
 - 2. Certified fan performance curves with system operating conditions indicated.
 - 3. Certified fan sound-power ratings.
 - 4. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 5. Material thickness and finishes, including color charts.
 - 6. Fan speed controllers.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies. Show dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.
- C. Delegated-Design Submittal: For each HVLS fan.
 - 1. Include design calculations and details for selecting product mounting components and seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 2. Design Calculations: Calculate static and dynamic loading due to equipment weight, operation, and seismic forces required to select mounting components and seismic restraints.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans and details, drawn to scale and coordinated with each other, using input from installers of the items involved.
- B. Qualification Data:
 - 1. For Installer: Certificate from HVLS fan manufacturer certifying that Installer has successfully completed prerequisite training administered by manufacturer for proper installation of systems, including but not limited to, equipment, controls, and accessories indicated and furnished for installation.
- C. Seismic-Restraint Details:
 - 1. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - 2. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
- D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For HVLS fans to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Provide certification that manufacturer complies with the most recent edition of ISO 9001.
- B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by HVLS fan manufacturer.
 - 1. Each employee shall be certified by manufacturer for proper installation of systems, including, but not limited to, equipment, controls, and accessories indicated and furnished for installation.
 - 2. Installer certification shall be valid and current for duration of Project.
 - 3. Retain copies of Installer certificates on-site and make available on request.
 - 4. Each person assigned to Project shall have demonstrated past experience.
 - a. Demonstrated past experience with products being installed for period within five consecutive years before time of bid.
 - b. Demonstrated past experience on five projects of similar complexity, scope, and value.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in a clean and dry place.
- B. Comply with manufacturer's written rigging and installation instructions for unloading and moving to final installed location.
- C. Handle products carefully to prevent damage, breaking, denting, and scoring. Do not install damaged products.
- D. Protect products from weather, dirt, dust, water, construction debris, and physical damage.
 - 1. Retain factory-applied coverings on equipment to protect finishes during construction and remove just prior to operating unit.
 - 2. Cover unit openings before installation to prevent dirt and dust from entering inside of units. If required to remove coverings during unit installation, reapply coverings over openings after unit installation and remove just prior to operating unit.
- E. Replace installed products damaged during construction.

1.9 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of fans that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period:
 - a. For Motor, Including Controls: Five year(s) from date of Substantial Completion.
 - b. For Parts, Including Blades and Hub: Five year(s) from date of Substantial Completion.
 - c. For Labor: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 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. UL Compliance: Listed and labeled to UL 507.
- C. CSA Compliance: Listed and labeled to CSA C22.2, No. 113.
- D. Comply with NFPA 13 requirements for HVLS fans.
- E. AMCA Compliance:
 - 1. Test HVLS fans according to AMCA 230.
 - 2. Certify HVLS fan performance according to AMCA 211.

- F. Performance Data: Comply with ANSI 230 test procedure standard, based on five rating points: 20-, 40-, 60-, 80-, and 100-percent of maximum speed. Comply with AMCA 211 for publication of performance data.
- G. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design HVLS ceiling fans.
- H. Seismic Performance: HVLS ceiling fans shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the HVLS fans will remain in place without separation of any parts when subjected to the seismic forces specified."
 - 2. Component Importance Factor: 1.0.

2.2 CAPACITIES AND CHARACTERISTICS

- A. See drawings

2.3 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Big Ass Fans.
 - 2. Greenheck.
 - 3. Hunter Fan Company; Industrial & Commercial Division.
 - 4. MacroAir.
 - 5. Zoo Fans.
- B. Source Limitations: Obtain HVLS fans from single source from single manufacturer.

2.4 HIGH-VOLUME, LOW-SPEED FANS

- A. Description: Factory-assembled and -tested horizontal, non-ducted fan unit, consisting of large-diameter blade set, direct-drive electric motor, with variable-speed motor controller.
 - 1. Provide fan designed to circulate large air volume, vertically, at low velocity.
 - 2. Maximum Operating Temperature: 140 (60) deg F (deg C).
 - 3. Frame:
 - a. Material: Aluminum, Galvanized steel, or Stainless steel.
 - 1) Finish: Powdercoat.
 - 4. Diameter: See drawings
 - 5. Blades: Airfoil type.
 - 1) Blade Finish: Anodized.
 - 6. Wiring and Controls Enclosure:

- a. NEMA 250, Class 4X.
 - b. Material: Aluminum, Galvanized steel, or Stainless steel.
 - c. Enclosure Finish: Powdercoat.
 - d. Grounded.
7. Controls: Provide wall-mounted keypad.
- a. Provide variable speed motor controller with fire alarm relay and BACnet compatibility.
8. Maximum Sound Power Level: 45 dBA.
9. Standard Mounting Bracket: Steel beam/steel angle.
10. Accessories:
- a. Mounting extension tube.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions for compliance with requirements for installation tolerances and other conditions affecting HVLS fan performance, maintenance, and operations.
 - 1. Fan locations indicated on Drawings are approximate. Determine exact locations before roughing-in for mounting, control, and electrical connections.
- B. Examine roughing-in for mounting location, anchor-bolt sizes, and locations, to verify actual locations for mounting connections before installation of fan.
- C. Examine areas for suitable conditions where fan will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF HIGH-VOLUME LOW-SPEED FANS

- A. Install fan according to manufacturer's published instructions.
- B. Comply with NECA 1 and NFPA 70.
- C. Comply with NFPA 13 for installation of HVLS fans and maximum allowable fan diameter. Center HVLS fans between four adjacent sprinklers. Minimum vertical clearance from HVLS fan to sprinkler deflector is 3 feet (0.9 m).
- D. Comply with NFPA 72 and interlock HVLS fans to shut down upon receiving an alarm from fire alarm system.

- E. Equipment Mounting:
 - 1. Anchor fan to building structure with manufacturer's recommended mounting bracket for installed condition.
 - 2. Consult a licensed professional structural engineer for mounting methods and approval for mounting to the structure. Structure must be able to withstand the torque and forces generated by the fan.
 - 3. Comply with requirements for hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
 - 4. Comply with requirements for vibration isolation and seismic-control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
 - 5. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- F. Install unit to permit access for maintenance.
- G. Install parts and accessories shipped loose.

3.3 ELECTRICAL CONNECTIONS

- A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
 - 1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
 - 2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least **1/2 inch (13 mm)** high.
- E. Install power wiring to field-mounted electrical devices, furnished by fan manufacturer, but not factory mounted.

3.4 CONTROL CONNECTIONS

- A. Connect control wiring to field-mounted control devices.
- B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."
- C. Connect control interlock wiring between HVLS fan and other equipment to provide a complete and functioning system.

- D. Connect control wiring between fan unit control interface and control system to provide remote control and monitoring.
- E. Install control devices furnished by manufacturer, but not factory mounted.
- F. Install control wiring to field-mounted control devices, furnished by fan manufacturer, but not factory mounted.
- G. Protect installed units from damage caused by other work.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency, Owner Engaged: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency, Contractor Engaged: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Fan or components will be considered defective if fan or components do not pass tests and inspections.
- F. Prepare and submit test and inspection reports.

3.6 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. Verify that fan is secure on mountings and supporting devices and that connections to electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers and switches.
 - 3. Verify proper motor rotation direction and free fan rotation.
 - 4. Check bearing and gearbox lubrication.
 - 5. Verify proper fan rotation. Set rotation selector to blow vertically downward during heating season, and vertically upward during cooling season.

3.7 ADJUSTING

- A. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

3.8 CLEANING

- A. Clean equipment externally; remove coatings applied for protection during shipping and storage, foreign material, and oily residue according to manufacturer's written instructions. Following manufacturer's cleaning procedures, and clean with manufacturer-recommended cleaning products.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVLS fans.
- B. Video training sessions, and provide electronic copy of video to Owner.

END OF SECTION 233439

SECTION 233713

DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Round ceiling diffusers.
2. Rectangular and square ceiling diffusers.
3. Perforated diffusers.
4. Louver face diffusers.
5. Linear bar diffusers.
6. Linear slot diffusers.
7. Adjustable bar grilles.
8. Fixed face grilles.
9. Linear bar grilles.

B. Related Sections:

1. Section 089116 "Operable Wall Louvers" and Section 089119 "Fixed Louvers" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Rectangular and Square Ceiling Diffusers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. [Anemostat Products; a Mestek company.](#)
- b. [Carnes Company.](#)
- c. [Hart & Cooley Inc.](#)
- d. [Krueger.](#)
- e. [Nailor Industries Inc.](#)
- f. [Price Industries.](#)
- g. [Shoemaker Mfg. Co.](#)
- h. [Titus.](#)
- i. [Tuttle & Bailey.](#)

- 2. Devices shall be specifically designed for variable-air-volume flows.
- 3. Material: Aluminum.
- 4. Finish: Baked enamel, color selected by Architect.
- 5. Face Size: See drawings
- 6. Face Style: See drawings
- 7. Mounting: See drawings
- 8. Pattern: See drawings
- 9. Dampers: Radial opposed blade.
- 10. Accessories:

- a. Equalizing grid.
- b. Plaster ring.
- c. Safety chain.
- d. Wire guard.
- e. Sectorizing baffles.
- f. Operating rod extension.

B. Perforated Diffuser:

- 1. [Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following:
 - a. [Anemostat Products; a Mestek company.](#)
 - b. [Carnes Company.](#)
 - c. [Hart & Cooley Inc.](#)
 - d. [Krueger.](#)
 - e. [Nailor Industries Inc.](#)
 - f. [Price Industries.](#)
 - g. [Shoemaker Mfg. Co.](#)
 - h. [Titus.](#)
 - i. [Tuttle & Bailey.](#)
- 2.
- 3. Devices shall be specifically designed for variable-air-volume flows.
- 4. Material: Steel backpan and pattern controllers, with aluminum face.
- 5. Finish: Baked enamel, color selected by Architect.
- 6. Face Size: See drawings
- 7. Duct Inlet: See drawings
- 8. Face Style: Flush.
- 9. Mounting: See drawings.
- 10. Pattern Controller: None.
- 11. Dampers: None
- 12. Accessories:

- a. Equalizing grid.
- b. Plaster ring.
- c. Safety chain.
- d. Wire guard.
- e. Sectorizing baffles.
- f. Operating rod extension.

C. Louver Face Diffuser:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. [Anemostat Products; a Mestek company.](#)
- b. [Carnes Company.](#)
- c. [Hart & Cooley Inc.](#)
- d. [Krueger.](#)
- e. [Nailor Industries Inc.](#)
- f. [Price Industries.](#)
- g. [Shoemaker Mfg. Co.](#)
- h. [Titus.](#)
- i. [Tuttle & Bailey.](#)

2. Devices shall be specifically designed for variable-air-volume flows.

3. Material: Aluminum.

4. Finish: Baked enamel, color selected by Architect.

5. Face Size: See drawings

6. Mounting: See Drawings

7. Pattern: See Drawings

8. Dampers: Radial opposed blade.

9. Accessories:

- a. Square to round neck adaptor.
- b. Adjustable pattern vanes.
- c. Throw reducing vanes.
- d. Equalizing grid.
- e. Plaster ring.
- f. Safety chain.
- g. Wire guard.
- h. Sectorizing baffles.
- i. Operating rod extension.

2.2 CEILING LINEAR SLOT OUTLETS

A. Linear Bar Diffuser:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. [Anemostat Products; a Mestek company.](#)
- b. [Carnes Company.](#)
- c. [Hart & Cooley Inc.](#)
- d. [Krueger.](#)
- e. [Nailor Industries Inc.](#)

- f. [Price Industries.](#)
 - g. [Shoemaker Mfg. Co.](#)
 - h. [Titus.](#)
 - i. [Tuttle & Bailey.](#)
2. Devices shall be specifically designed for variable-air-volume flows.
 3. Material: Aluminum.
 4. Finish: Baked enamel, color selected by Architect.
 5. Narrow Core Spacing Arrangement: **1/8-inch-** (3-mm-) thick blades spaced **1/4 inch (6 mm)** apart, 15-degree deflection.
 6. Frame: **1 inch (25 mm)** wide.

B. Linear Slot Diffuser:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [Anemostat Products; a Mestek company.](#)
 - b. [Carnes Company.](#)
 - c. [Hart & Cooley Inc.](#)
 - d. [Krueger.](#)
 - e. [Nailor Industries Inc.](#)
 - f. [Price Industries.](#)
 - g. [Shoemaker Mfg. Co.](#)
 - h. [Titus.](#)
 - i. [Tuttle & Bailey.](#)
2. Devices shall be specifically designed for variable-air-volume flows.
3. Material - Shell: Aluminum,.
4. Material - Pattern Controller and Tees: Aluminum.
5. Finish - Face and Shell: Baked enamel, black.
6. Finish - Pattern Controller: Baked enamel, black.
7. Finish - Tees: Baked enamel, color selected by Architect.
8. Slot Width: See drawings.
9. Number of Slots: See drawings.
10. Length: See Drawings.
11. Accessories: Engineered plenum.

2.3 REGISTERS AND GRILLES

A. Adjustable Bar Register:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [Anemostat Products; a Mestek company.](#)
 - b. [Carnes Company.](#)
 - c. [Hart & Cooley Inc.](#)
 - d. [Krueger.](#)
 - e. [Nailor Industries Inc.](#)
 - f. [Price Industries.](#)
 - g. [Shoemaker Mfg. Co.](#)
 - h. [Titus.](#)

- i. Tuttle & Bailey.
2. Material: Aluminum.
3. Finish: Baked enamel, color selected by Architect.
4. Face Blade Arrangement: Horizontal spaced 1/2 inch (13 mm) apart.
5. Core Construction: Integral.

2.4 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 235116

FABRICATED BREECHINGS AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Type B double wall gas vents
2. Custom-Designed, steel single wall system
3. Pre-engineered, Pre-Fabricated, Double-Wall System
4. Guying and bracing materials.
5. Accessories

B. Related Requirements:

1. Section 235113.11 "Draft Control Fans" for draft inducer fans, venturi-draft inducer fans, mechanical-draft vent fans, vent exhaust fans, and combustion-air fans.
2. Section 235113.16 "Vent Dampers" for motorized and barometric dampers.
3. Section 235123 "Gas Vents" for Type B and BW vents, Type L vents, and listed special gas vents.
4. Section 235133 "Insulated Sectional Chimneys" for listed chimney liners; listed building-heating-appliance chimneys; listed, refractory-lined metal chimneys; and field-fabricated chimneys.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For breechings.

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of hangers and seismic restraints.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Seismic Qualification Certificates: For factory-fabricated breeching, accessories, and components from manufacturer.

C. Sample Warranty: For special warranty.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 - 2. AWS D9.1/D9.1M, "Sheet Metal Welding Code," for shop and field welding of joints and seams in breechings.
- B. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

PART 2 - PRODUCTS

2.1 TYBE B DOUBLE WALL GAS VENTS

- A. Fabrication: Inner pipe of sheet aluminum, and outer pipe of galvanized sheet steel, tested in compliance with UL 441.

2.2 CUSTOM-DESIGNED, STEEL SINGLE WALL SYSTEM

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - 1. Ampco
 - 2. Dura Vent
 - 3. Enervex
 - 4. Heat Fab
 - 5. Jerimias
 - 6. Van Packer Company
- B. The factory-built vent system shall be designed and installed to be liquid tight and thus prevent leakage of the exhaust into the building.
- C. The system shall be designed to compensate for all thermal expansion.
- D. The single wall exhaust shall be of type 304 (or 316) stainless steel. Minimum steel thickness shall be 0.035" (or 0.048").
- E. Pipe joints shall be sealed by use of factory supplied overlapping V-Bands and sealant.
- F. The entire system from outlet to the termination; including accessories, except as noted; shall be from the manufacturer.
- G. The diameter for the exhaust shall be verified by the manufacturers' computations. The computation shall be technically sound, shall follow ASHRAE calculation methods, and incorporate the specific flow characteristics of the pipe.
- H. The system shall be listed as a chimney liner per ULC-S635 (Standard for Chimney Liners for Existing Chimneys),
- I. Heavy hex ASTM A307 Grade B machine bolts. Heavy hex ASTM A563 Grade C nuts. Provide washers under bolts and nuts. Bolts, nuts and washers cadmium plated.

- J. Provide angle clips for attachment of insulation.
- K. Roof penetrations shall conform to Section 07 60 00, FLASHING and SHEET METAL.
- L. Rain cap shall be double cone arrangement, welded, supported by angles.
- M. Support with rigid and spring supports attached to the building structure. Supports shall be designed to completely support the system without overloading the connecting equipment or the building structure. Thermal expansion shall be accommodated by expansion joints and MSS SP-58, Type 51 variable spring hangers (if necessary).
- N. Provide guy wires on stacks with spring-loaded tensioners as shown on the drawings.
- O. Clean all surfaces of rust, mill scale, and apply prime coat of heat and corrosion resistant paint. Apply finish coats of heat and corrosion resistant paint to all exposed uninsulated surfaces. Select paint system compatible with maximum surface temperature. Refer to Section 09 91 00, PAINTING.

2.3 PRE-ENGINEERED, PRE-FABRICATED, DOUBLE-WALL SYSTEM

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 1. Ampco
 2. Dura Vent
 3. Enervex
 4. Heat Fab
 5. Jerimias
 6. Van Packer Company
- B. Complete factory-built system, all components and installation engineered and provided by manufacturer of system.
- C. Provide double wall metal stacks, tested to UL 103 and UL listed, for use with building heating equipment, in compliance with NFPA 211.
- D. Corrosion resistant steel, double wall, circular cross section, positive pressure, blanket insulation between walls.
- E. Factory built standard sections, connected in the field with joining system designed and provided by system manufacturer. Designed to be pressure and vacuum tight, no deformation, at the service conditions specified.
- F. System manufacturer's engineered support system, attached to structural members of the building, with expansion joints between rigid supports. Thermal expansion shall be handled by expansion joints and variable spring hangers. Thermal expansion and weight of system shall not impose loads in excess of that allowed by manufacturer of boiler, economizer, or any other equipment, or exceed capabilities of building structure. Spring hangers shall conform to MSS SP-58, Type 51, variable spring.
- G. UL-listed for zero inch clearance to combustible materials and zero inch clearance to non-combustible materials.

- H. Inner Wall: Stainless steel, Type 304 0.035 inch minimum thickness for diameters 36 inches and smaller.
- I. Outer Wall: Stainless steel, Type 304 0.025 inch minimum thickness for inner wall diameter 32 inches and less.
- J. Uninsulated Air Space between Inner and Outer Walls : one inch minimum.
- K. Bands for Joining Sections: Same material as section being joined. Utilize sealant provided by system manufacturer.
- L. Roof and wall penetrations shall be manufacturer's standard ventilated thimble. Conform to Section 07 60 00, FLASHING and SHEET METAL.
- M. Stack Outlet: Provide as shown, double cone rain cap or other type termination designed by manufacturer of the stack system.
- N. Drain Section: Provide inside building below roof to drain rain water from stack. Extend drain pipe to floor drain.
- O. Guys: Provide stack guy wires above roof, with spring-loaded tensioners, in accordance with printed instructions of stack manufacturer.

2.4 GUYING AND BRACING MATERIALS

- A. Cable: Four galvanized, stranded wires of the following thickness:
 1. Minimum Size: 1/4 inch (6 mm) in diameter.
 2. For ID Sizes 4 to 15 Inches (100 to 381 mm): 5/16 inch (8 mm).
 3. For ID Sizes 18 to 24 Inches (457 to 610 mm): 3/8 inch (9.5 mm).
 4. For ID Sizes 27 to 30 Inches (685 to 762 mm): 7/16 inch (11 mm).
 5. For ID Sizes 33 to 36 Inches (838 to 915 mm): 1/2 inch (13 mm).
 6. For ID Sizes 39 to 48 Inches (990 to 1220 mm): 9/16 inch (14.3 mm).
 7. For ID Sizes 51 to 60 Inches (1295 to 1524 mm): 5/8 inch (16 mm).
- B. Pipe: Three galvanized steel, NPS 1-1/4 (DN 32).
- C. Angle Iron: Three galvanized steel, 2 by 2 by 0.25 inch (50 by 50 by 6 mm).

2.5 ACCESSORIES

- A. EXPANSION JOINTS
 1. Provide sufficient types, quantities, and locations of expansion joints to completely absorb all thermal expansion of the system without imposing excessive loads on equipment or building structure. Fabric joints shall be used on single wall stack and breeching system. On factory fabricated double wall stack or breeching system, use slip type, bellows type, or fabric expansion joints engineered by designer of the stack and breeching system.
 2. Service: Design for 575 F, 20 inches WC positive and negative internal pressure, continuous duty.
 3. Construction, Fabric Joints:
 - a. Fabric: High strength, designed for dewpoint service.

- b. Internal Baffles: Carbon steel with stiffeners. Designed to protect interior surfaces of fabric from wiping action of the flue gases.
 - c. Welded frame, 6 mm (1/4 inch) thick ASTM A568 steel with 100mm (4 inch) minimum flange height, flat-belt design, fabricated by expansion joint manufacturer. Fabric element bolting, 9 mm (3/8 inch) diameter, 150 mm (6 inch) maximum centers.
 - 4. Construction, Factory Fabricated Double-Wall System Joints:
 - a. Materials: Same as factory fabricated breeching system.
 - b. Packing Gland: High temperature rating. Provide seal between sliding and fixed portions of joint.
- B. Drains: Provide threaded pipe connection to allow drainage at all low points and drain connections in stack and breeching systems. Slope piping system to the drain. Pipe size shall be 25 mm (1 inch) minimum.
- C. Instrument Ports: Locate on individual stack or breeching serving each boiler. Locate in non-turbulent zone within 3600 mm (12 feet) of boiler room floor between boiler and economizer (when economizer is provided) or locate accessible from platform. Provide separate ports for the following:
 - 1. Flue gas oxygen analyzer: Coordinate with analyzer furnished.
 - 2. Opacity monitor (if required): Coordinate with sensor furnished. Locate downstream from oxygen analyzer.
 - 3. Stack temperature sensor: Coordinate with sensor furnished.
 - 4. Draft gauge: 25 mm (1 inch) diameter coupling, plugged.
 - 5. Test instruments: 25 mm (1 inch) diameter coupling, plugged.
- D. Access Doors: Bolted, gasketed, insulated, with handles. Provide where shown. Minimum opening 400 mm x 400 mm (16 inches x 16 inches).

PART 3 - EXECUTION

3.1 INSTALLATION OF BREECHINGS

- A. Install breechings on boilers, oven vents, water heaters, fireplaces, and other gas-burning appliances.
- B. Suspend breechings independent of their appliance connections.
- C. Install seismic restrains according to manufacturer's written instructions. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC."
- D. Align breechings at connections, with smooth internal surface and a maximum 1/8-inch (3-mm) misalignment tolerance.
- E. Slope breechings down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain.
- F. Lap joints in direction of flow.
- G. Support breechings from building structure with bolts, concrete inserts, steel expansion anchors, welded studs, C clamps, or beam clamps.

- H. Clean breechings internally, during and after installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth and apply touchup finish to match factory or shop finish.
- I. After completing system installation, remove burrs, dirt, and construction debris, and repair damaged finishes.
- J. Provide temporary closures at ends of breechings that are not completed or connected to equipment.
- K. Install per NFPA 54 and IFGC.

END OF SECTION 235116

SECTION 235216
CONDENSING BOILERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes gas-fired, boilers, trim, and accessories for generating hot water.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Include diagrams for power, signal, and control wiring.
- B. Delegated-Design Submittal: For each boiler.
 - 1. Design calculations and vibration isolation base details, signed and sealed by a qualified professional engineer.
 - a. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 - b. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.3 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For boiler, accessories, and components, from manufacturer.
- B. Source quality-control reports.
- C. Field quality-control reports.
- D. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Fire-Tube Condensing Boilers:
 - a. Leakage and Materials: 10 Insert number years from date of Substantial Completion.
 - b. Heat Exchanger Damaged by Thermal Stress and Corrosion: Nonprorated for five years from date of Substantial Completion.
2. Warranty Period for Water-Tube Condensing Boilers: 20 years from date of Substantial Completion.
3. Warranty Period for Water-Jacketed Condensing Boilers:
 - a. Leakage and Materials: Eight years from date of Substantial Completion.
 - b. Heat Exchanger Damaged by Thermal Stress and Corrosion: Nonprorated for five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Summary: Condensing, modulating boiler with minimum 10:1 turn down.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. ASME Compliance: Fabricate and label boilers to comply with 2010 ASME Boiler and Pressure Vessel Code.
- D. ASHRAE/IES 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."
- E. DOE Compliance: Minimum efficiency shall comply with 10 CFR 430, Subpart B, Appendix N.
- F. UL Compliance: Test boilers for compliance with UL 795. Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.
- G. CSA Compliance: Test boilers for compliance with CSA B51.
- H. Mounting Base: For securing boiler to concrete base.
 1. Seismic Fabrication Requirements: Fabricate mounting base and attachment to boiler pressure vessel, accessories, and components with reinforcement strong enough to withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC" when mounting base is anchored to building structure.

2.2 CONDENSING BOILERS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 1. [AERCO International, Inc.](#)
 2. [Cleaver-Brooks.](#)
 3. Lochinvar.

- B. Heat Exchanger: Nonferrous, corrosion-resistant combustion chamber.
- C. Pressure Vessel: Carbon steel with welded heads and tube connections.
- D. Burner: Natural gas, forced draft.
- E. Blower: Centrifugal fan to operate during each burner firing sequence and to pre-purge and post-purge the combustion chamber.
 - 1. Motors: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - a. Motor Sizes: Minimum size as indicated; if not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- F. Gas Train: Combination gas valve with manual shutoff and pressure regulator.
- G. Ignition: Spark ignition with 100 percent main-valve shutoff with electronic flame supervision.
- H. Casing:
 - 1. Jacket: Sheet metal, with snap-in or interlocking closures.
 - 2. Control Compartment Enclosures: NEMA 250, Type 1A.
 - 3. Finish: Baked-enamel or Powder-coated protective finish.
 - 4. Insulation: Minimum 2-inch-thick insulation surrounding the heat exchanger.
 - 5. Combustion-Air Connections: Inlet and vent duct collars.
- I. Capacities and Characteristics: See Drawings

2.3 TRIM

- A. Include devices sized to comply with ASME B31.1.
- B. Aquastat Controllers: Operating, firing rate, and high limit.
- C. Safety Relief Valve: ASME rated.
- D. Pressure and Temperature Gage: Minimum 3-1/2-inch-diameter, combination water-pressure and -temperature gage. Gages shall have operating-pressure and -temperature ranges, so normal operating range is about 50 percent of full range.
- E. Drain Valve: Minimum NPS 3/4 hose-end gate valve.
- F. Low and high gas pressure switches shall accomplish a safety shutdown and lockout before the manifold gas pressure is less than 50% or exceeds 150% of the boiler/ burner's main manifold gas pressure.
 - 1. The low gas pressure switch shall be located upstream of the safety shutoff valves(s).
 - 2. The high gas pressure switch shall be located downstream of the gas pressure regulator and may be located downstream of all main burner gas supply controls.

2.4 CONTROLS

- A. Refer to Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."
- B. Boiler operating controls shall include the following devices and features:
 - 1. Control transformer.
 - 2. Set-Point Adjust: Set points shall be adjustable.
 - 3. Sequence of Operation: Electric, factory-fabricated and field-installed panel to control burner firing rate to maintain space temperature in response to thermostat with heat anticipator located in heated space.
 - a. Include automatic, alternating-firing sequence for multiple boilers to ensure maximum system efficiency throughout the load range and to provide equal runtime for boilers.
 - 4. Sequence of Operation: Electric, factory-fabricated and field-installed panel to control burner firing rate to reset supply-water temperature inversely with outside-air temperature. At 0 deg F Insert temperature outside-air temperature, set supply-water temperature at 180 deg F Insert temperature; at 60 deg F Insert temperature outside-air temperature, set supply-water temperature at 100 deg F Insert temperature.
 - a. Include automatic, alternating-firing sequence for multiple boilers to ensure maximum system efficiency throughout the load range and to provide equal runtime for boilers.
- C. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.
 - 1. High Cutoff: Automatic reset stops burner if operating conditions rise above maximum boiler design temperature.
 - 2. Low-Water Cutoff Switch: Electronic probe shall prevent burner operation on low water. Cutoff switch shall be automatic-reset type.
 - 3. Blocked Inlet Safety Switch: Manual-reset pressure switch field mounted on boiler combustion-air inlet.
 - 4. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.
- D. Building Automation System Interface: Factory install hardware and software to enable building automation system to monitor, control, and display boiler status and alarms. Provide with BACnet controller.
 - 1. Hardwired Points:
 - a. Monitoring: On/off status, common trouble alarm low-water-level alarm.
 - b. Control: On/off operation, hot-water-supply temperature set-point adjustment.
 - 2. A communication interface with building automation system shall enable building automation system operator to remotely control and monitor the boiler from an operator workstation. Control features available, and monitoring points displayed, locally at boiler control panel shall be available through building automation system.

2.5 ELECTRICAL POWER

- A. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in electrical Sections.
- B. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.
 - 1. House in NEMA 250, Type 1 enclosure.
 - 2. Wiring shall be numbered and color coded to match wiring diagram.
 - 3. Install factory wiring outside of an enclosure in a raceway.
 - 4. Provide each motor with overcurrent protection.

2.6 VENTING KITS

- A. Kit: Complete system, ASTM A 959, Type 29-4C stainless steel, pipe, vent terminal, thimble, indoor plate, vent adapter, condensate trap and dilution tank, and sealant.
- B. Combustion-Air Intake: Complete system, stainless steel, pipe, vent terminal with screen, inlet air coupling, and sealant.

2.7 SOURCE QUALITY CONTROL

- A. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.
- B. Test and inspect factory-assembled boilers, before shipping, according to 2010 ASME Boiler and Pressure Vessel Code.

PART 3 - EXECUTION

3.1 BOILER INSTALLATION

- A. Equipment Mounting:
 - 1. Install boilers with a minimum of 18" (3' for boilers over 4,000,000 btu/hr) clearance on all sides and above the boiler.
 - 2. Install boilers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in other.
 - 3. Comply with requirements for vibration isolation and seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
 - 4. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- B. Install gas-fired boilers according to NFPA 54.
- C. Assemble and install boiler trim.
- D. Install electrical devices furnished with boiler but not specified to be factory mounted.

- E. Install control wiring to field-mounted electrical devices.
- F. Provide a manually operated remote shutdown switch located at the exit of the boiler room and marked for easy identification, If there is more than one door to the boiler room, there shall be a switch located at each door.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to boiler to allow service and maintenance.
- C. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.
- D. Connect piping to boilers, except safety relief valve connections, with flexible connectors of materials suitable for service. Flexible connectors and their installation are specified in Section 232116 "Hydronic Piping Specialties."
- E. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas-train connection. Provide a reducer if required.
- F. Connect hot-water piping to supply- and return-boiler tapings with shutoff valve and union or flange at each connection.
- G. Install piping from safety relief valves to nearest floor drain.
- H. Boiler Venting:
 - 1. Install flue venting kit and combustion-air intake.
 - 2. Connect full size to boiler connections. Comply with requirements in Section 235123 "Gas Vents."
- I. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- J. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Perform installation and startup checks according to manufacturer's written instructions.
 - 2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

- a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level, and water temperature.
 - b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- B. Boiler will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.
- D. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to 4 visits to Project during other-than-normal occupancy hours for this purpose.

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain boilers. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 235216

SECTION 235416.13

GAS-FIRED FURNACES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Gas-fired, condensing furnaces and accessories complete with controls.
2. Air filters.
3. Humidifiers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Include diagrams for power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.4 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace the following components of furnaces that fail in materials or workmanship within specified warranty period:

1. Warranty Period, Commencing on Date of Substantial Completion:
 - a. Furnace Heat Exchanger: 10 years.
 - b. Integrated Ignition and Blower Control Circuit Board: Five years.
 - c. Draft-Inducer Motor: Five years.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a qualified testing agency, and marked for intended location and application.

- B. General Requirements for Noncondensing Gas-Fired Furnaces: Factory assembled, piped, wired, and tested; complying with ANSI Z21.47/CSA 2.3 and NFPA 54.

2.2 GAS-FIRED FURNACES, CONDENSING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carrier Corporation; a unit of United Technologies Corp.
 - 2. Lennox Industries, Inc.; Lennox International.
 - 3. Trane.
 - 4. YORK; a Johnson Controls company.
- B. Cabinet: Galvanized steel.
 - 1. Cabinet interior around heat exchanger shall be factory-installed insulation.
 - 2. Lift-out panels shall expose burners and all other items requiring access for maintenance.
 - 3. Factory paint external cabinets in manufacturer's standard color.
 - 4. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Fan: Centrifugal, factory balanced, resilient mounted, direct drive.
 - 1. Fan Motors: Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - 2. Special Motor Features: Single speed, premium efficiency, as defined in Section 230513 "Common Motor Requirements for HVAC Equipment," and with internal thermal protection and permanent lubrication.
 - 3. Special Motor Features: Multitapped, multispeed with internal thermal protection and permanent lubrication.
 - 4. Special Motor Features: Electronically controlled motor (ECM) controlled by integrated furnace/blower control.
- D. Type of Gas: Propane
- E. Heat Exchanger:
 - 1. Primary: Aluminized steel.
 - 2. Secondary: Stainless steel.
- F. Burner:
 - 1. Gas Valve: 100 percent safety modulating main gas valve, main shutoff valve, pressure regulator, safety pilot with electronic flame sensor, limit control, transformer, and combination ignition/fan timer control board.
 - 2. Ignition: Electric pilot ignition, with hot-surface igniter or electric spark ignition.
- G. Gas-Burner Safety Controls:
 - 1. Electronic Flame Sensor: Prevents gas valve from opening until pilot flame is proven; stops gas flow on ignition failure.
 - 2. Flame Rollout Switch: Installed on burner box; prevents burner operation.
 - 3. Limit Control: Fixed stop at maximum permissible setting; de-energizes burner on excessive bonnet temperature; automatic reset.

- H. Combustion-Air Inducer: Centrifugal fan with thermally protected motor and sleeve bearings prepurges heat exchanger and vents combustion products; pressure switch prevents furnace operation if combustion-air inlet or flue outlet is blocked.
- I. Furnace Controls: Solid-state board integrates ignition, heat, cooling, and fan speeds; adjustable fan-on and fan-off timing; terminals for connection to accessories; diagnostic light with viewport.
- J. Accessories:
 - 1. Combination Combustion-Air Intake and Vent: PVC plastic fitting to combine combustion-air inlet and vent through outside wall or roof.
 - 2. CPVC Plastic Vent Materials:
 - a. CPVC Plastic Pipe: Schedule 40, complying with ASTM F 441/F 441M.
 - b. CPVC Plastic Fittings: Schedule 40, complying with ASTM F 438, socket type.
 - c. CPVC Solvent Cement: ASTM F 493.
 - 3. PVC Plastic Vent Materials:
 - a. PVC Plastic Pipe: Schedule 40, complying with ASTM D 1785.
 - b. PVC Plastic Fittings: Schedule 40, complying with ASTM D 2466, socket type.
 - c. PVC Solvent Cement: ASTM D 2564.
- K. Capacities and Characteristics: see drawings

2.3 THERMOSTATS AND HUMIDISTATS

- A. Controls shall comply with requirements in ASHRAE/IES 90.1, "Controls."
- B. Solid-State Thermostat: Wall-mounted, programmable, microprocessor-based unit with automatic switching from heating to cooling, preferential rate control, seven-day programmability with minimum of four temperature presets per day, vacation mode, and battery backup protection against power failure for program settings.
- C. Solid-State, Combination Thermostat and Humidistat (where indicated): Wall-mounted, programmable, microprocessor-based unit with automatic switching from heating to cooling and humidifying to dehumidifying, preferential rate control, seven-day programmability with minimum of four temperature presets per day, vacation mode, and battery backup protection against power failure for program settings.
- D. Control Wiring: Unshielded twisted-pair cabling.
 - 1. No. 24 AWG, 100 ohm, four pair.
 - 2. Cable Jacket Color: Blue.
- E. Disposable Filters: 1-inch-thick fiberglass media with ASHRAE 52.2 MERV rating of 6 or higher, in sheet metal frame.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install gas-fired furnaces and associated fuel and vent features and systems according to NFPA 54.
- B. Suspended Units: Suspend from structure using threaded rods, spring hangers, and building attachments. Secure rods to unit hanger attachments. Adjust hangers so unit is level and plumb.
- C. Base-Mounted Units: Secure units to substrate. Provide optional bottom closure base if required by installation conditions.
- D. Controls: Install thermostats and humidistats at mounting height of 60 inches above floor.
- E. Wiring Method: Install control wiring in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal control wiring except in unfinished spaces.

3.2 CONNECTIONS

- A. Gas piping installation requirements are specified in Section 231123 "Facility Natural-Gas Piping." Drawings indicate general arrangement of piping, fittings, and specialties. Connect gas piping with union or flange and appliance connector valve.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Water piping installation requirements are specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties. Connect water piping with union and ball valve.
- D. Vent Connection, Noncondensing, Gas-Fired Furnaces: Connect Type B vents to furnace vent connection and extend outdoors. Type B vents and their installation requirements are specified in Section 235123 "Gas Vents."
- E. Vent and Outside-Air Connection, Condensing, Gas-Fired Furnaces: Connect plastic piping vent material to furnace connections and extend outdoors. Terminate vent outdoors with a cap and in an arrangement that will protect against entry of birds, insects, and dirt.
 - 1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 - 2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 - 3. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - b. CPVC Piping: Join according to ASTM D 2846/D 2846M, Appendix.
 - c. 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.

4. Slope pipe vent back to furnace or to outside terminal.
- F. Connect ducts to furnace with flexible connector. Comply with requirements in Section 233300 "Air Duct Accessories."

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
1. Perform electrical test and visual and mechanical inspection.
 2. Leak Test: After installation, charge systems with refrigerant and test for leaks. Repair leaks, replace lost refrigerant, and retest until no leaks exist.
 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation, product capability, and compliance with requirements.
 4. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.
 5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

END OF SECTION 235416.13

SECTION 235523.13

LOW-INTENSITY, GAS-FIRED, RADIANT HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes low-intensity, gas-fired, forced-draft radiant heaters.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace components of radiant heaters that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: All warranty periods listed below are from date of Substantial Completion.
 - a. Burner Assembly: Five years.
 - b. Combustion and Emitter Tubes: Five years.
 - c. Heater Controls: One year(s).

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. CSA certified, with CSA Seal and certification number clearly visible on units indicating compliance with ANSI Z83.20/CSA 2.34.
- B. UL listed and labeled, with UL label clearly visible on units indicating compliance with ANSI Z83.20/CSA 2.34.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 FORCED-DRAFT HEATERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Detroit Radiant Products Company.
 - 2. Space-Ray; a division of Gas-Fired Products Inc.
 - 3. Sterling HVAC Products; a Mestek company.
 - 4. Superior Radiant Products Ltd.
- B. Description: Factory-assembled, indoor, overhead-mounted, electrically controlled, low-intensity, infrared radiant heating units using gas combustion. Heater to have all necessary factory-installed wiring and piping required prior to field installation and startup.
- C. Fuel Type: Design burner for natural gas having characteristics same as those of gas available at Project site.
- D. Burner Assembly:
 - 1. Combustion-Air Inlet: Non-ducted, unvented.
 - 2. Combustion-Air Inlet: Ducted horizontal to outdoors through sidewall with vent caps.
 - 3. Combustion-Air Inlet: Ducted vertical to outdoors through roof with vent caps.
 - 4. Ignition System: Silicon carbide hot-surface igniter with flame rod sensing capabilities.
- E. Combustion Chamber: **4-inch- (100-mm-)** diameter, 12-gage, titanium-coated aluminized-steel tubing with high-emissivity, high-temperature, corrosion-resistant external finish.
- F. Emitter Tube: **4-inch- (100-mm-)** diameter, 12-gage, titanium-coated aluminized-steel tubing with high-emissivity, high-temperature, corrosion-resistant external finish.
 - 1. Tubing Connections: Stainless-steel threaded couplings.
- G. Reflector: High-grade steel with a heat- and corrosion-resistant, hot-bonded, aluminum-silicon alloy coating, with end caps. Shape to control radiation from tubing for uniform intensity at floor level with 100 percent cutoff above centerline of tubing. Reflectors or entire heater shall accommodate rotational adjustment from horizontal to a minimum 30-degree tilt from vertical.
- H. Capacities and Characteristics:

2.3 DRAFT-INDUCED HEATERS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
1. [Detroit Radiant Products Company.](#)
 2. [Space-Ray; a division of Gas-Fired Products Inc.](#)
 3. [Superior Radiant Products Ltd.](#)
- B. Description: Factory-assembled, indoor, overhead-mounted, electrically controlled, low-intensity, infrared radiant heating units using gas combustion. Heater to have all necessary factory-installed wiring and piping required prior to field installation and startup.
- C. Fuel Type: Design burner for natural gas having characteristics same as those of gas available at Project site.
- D. Burner Assembly:
1. Combustion-Air Inlet: Non-ducted, unvented.
 2. Combustion-Air Inlet: Ducted horizontal to outdoors through sidewall with vent caps.
 3. Combustion-Air Inlet: Ducted vertical to outdoors through roof with vent caps.
 4. Ignition System: Silicon carbide hot-surface igniter with flame rod sensing capabilities and self-diagnostic control module.
- E. Combustion Chamber: **4-inch- (100-mm-)** diameter, 12-gage, titanium-coated aluminized-steel tubing with high-emissivity, high-temperature, corrosion-resistant external finish.
- F. Emitter Tube: **4-inch- (100-mm-)** diameter, 12-gage, titanium-coated aluminized-steel tubing with high-emissivity, high-temperature, corrosion-resistant external finish.
1. Tubing Connections: Stainless-steel threaded couplings.
- G. Vacuum Exhaust Fan: Dynamically balanced, direct-driven, isolated from emitter tubing exhaust system by high-temperature flexible vibration isolation connector. Fan and connector to have a minimum temperature rating of **450 deg F (232 deg C)**.
1. Motors: General requirements for motors are specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 2. Balancing Dampers: Plate type, mounted in cast, double-flange fitting with vacuum test plug.
 3. Filter: Cartridge type for mounting on burner housing.
 4. Vent Termination: Vertical through roof with vent caps.
- H. Reflector: High-grade steel with a heat- and corrosion-resistant, hot-bonded, aluminum-silicon alloy coating, with end caps. Shape to control radiation from tubing for uniform intensity at floor level with 100 percent cutoff above centerline of tubing. Reflectors or entire heater shall accommodate rotational adjustment from horizontal to a minimum 30-degree tilt from vertical.

2.4 CONTROLS AND SAFETIES

- A. Gas Control Valve: Single Two-stage, regulated redundant 24-V ac gas valve that contains pilot solenoid valve, electric gas valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff all in one body.

- B. Failure Safeguards: 100 percent shutoff of gas flow in the event of flame or power failure.
- C. Pre-purge of 15 seconds of air control system prior to burner ignition.
- D. Safety lockout of burner after three consecutive ignition failures.
- E. Blocked Vent Safety: Differential pressure switch in burner safety circuit to stop burner operation with high discharge or suction pressure.
- F. Control Panel Interlock: Stops burner if panel is open.
- G. Indicator Lights: "Airflow-on" and "burner-on" indicator lights.
- H. Thermostat: Devices and wiring are specified in Section 230923.27 "Temperature Instruments."
- I. Thermostat: Single-stage, wall-mounted type with 50 to 90 deg F (10 to 32 deg C) operating range and fan on switch.
 - 1. Control Transformer: Integrally mounted.
- J. Thermostat: Two-stage, wall-mounted type with 50 to 90 deg F (10 to 32 deg C) operating range and fan on switch.
 - 1. Control Transformer: Integrally mounted.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Equipment Installation: Install gas-fired, radiant heaters and associated gas features and systems according to NFPA 54.
- B. Suspended Units: Suspend from substrate using chain hanger kits and building attachments.
 - 1. Restrain the unit to resist seismic acceleration. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
 - 2. Comply with requirements for hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- C. Maintain manufacturers' recommended clearances for combustibles.
- D. Gas Piping: Comply with Section 231123 "Facility Natural-Gas Piping." Section 231126 "Facility Liquefied-Petroleum Gas Piping." Connect gas piping to gas train inlet; provide union with enough clearance for burner removal and service.
 - 1. Gas Connections: Connect gas piping to radiant heaters according to NFPA 54.
- E. Where installing piping adjacent to gas-fired, radiant heaters, allow space for service and maintenance.
- F. Vent Connections: Comply with Section 233113 "Metal Ducts" and with Section 235123 "Gas Vents."

G. Electrical Connections: Comply with applicable requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

1. Install electrical devices furnished with heaters but not specified to be factory mounted.

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
2. Verify bearing lubrication.
3. Verify proper motor rotation.
4. Test Reports: Prepare a written report to record the following:
 - a. Test procedures used.
 - b. Test results that comply with requirements.
 - c. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

B. Gas-fired, radiant heaters will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.3 ADJUSTING

A. Adjust initial-temperature set points.

B. Adjust burner and other unit components for optimum heating performance and efficiency.

END OF SECTION 235523.13

SECTION 236200

PACKAGED COMPRESSOR AND CONDENSER 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 packaged, refrigerant compressor and condenser units.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Compressor and condenser units shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.4 ACTION SUBMITTALS

- A. Product Data: For each compressor and condenser unit. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include equipment dimensions, weights and structural loads, required clearances, method of field assembly, components, and location and size of each field connection.
- B. Shop Drawings: For compressor and condenser units. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Delegated-Design Submittal: For compressor and condenser units indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
 - 2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Structural members to which compressor and condenser units will be attached.
 - 2. Liquid and vapor pipe sizes.
 - 3. Refrigerant specialties.
 - 4. Piping including connections, oil traps, and double risers.
 - 5. Compressors.
 - 6. Evaporators.
- B. Seismic Qualification Certification: For compressor and condenser units, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.
- D. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For compressor and condenser units to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Fabricate and label refrigeration system according to ASHRAE 15, "Safety Standard for Refrigeration Systems."
- C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6, "Heating, Ventilating, and Air-Conditioning."
- D. ASME Compliance: Fabricate and label water-cooled compressor and condenser units to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-In-Place Concrete" and Section 033053 "Miscellaneous Cast-In-Place Concrete."

- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."
- C. Coordinate location of piping and electrical rough-ins.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of compressor and condenser units that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Compressor failure.
 - b. Condenser coil leak.
 - 2. Warranty Period: Five years from date of Substantial Completion.
 - 3. Warranty Period (Compressor Only): Five years from date of Substantial Completion.
 - 4. Warranty Period (Components Other Than Compressor): Five years from date of Substantial Completion.
 - 5. Warranty Period (Condenser Coil Only): Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 COMPRESSOR AND CONDENSER UNITS, AIR COOLED, 1 TO 5 TONS (3.5 TO 17.6 kW)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carrier Corporation; a unit of United Technologies Corp.
 - 2. Trane.
 - 3. YORK; a Johnson Controls company.
- B. Description: Factory assembled and tested; consisting of compressor, condenser coil, fan, motors, refrigerant reservoir, and operating controls.
- C. Compressor: Scroll, hermetically sealed, with rubber vibration isolators.
 - 1. Motor: Single speed, and includes thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - 2. Two-Speed Compressor: Include manual-reset, high-pressure switch and automatic-reset, low-pressure switch.
 - 3. Accumulator: Suction tube.
- D. Refrigerant: R-407C or R-410A.
- E. Condenser Coil: Seamless copper-tube, aluminum-fin coil; circuited for integral liquid subcooler, with removable drain pan and brass service valves with service ports.
- F. Condenser Fan: Direct-drive, aluminum propeller fan; with permanently lubricated, totally enclosed fan motor with thermal-overload protection and ball bearings.

G. Accessories:

1. Coastal Filter: Mesh screen to protect condenser coil from salt damage.
2. Crankcase heater.
3. Cycle Protector: Automatic-reset timer to prevent rapid compressor cycling.
4. Electronic programmable thermostat to control compressor and condenser unit and evaporator fan.
5. Evaporator Freeze Thermostat: Temperature-actuated switch that stops unit when evaporator reaches freezing temperature.
6. Filter-dryer.
7. High-Pressure Switch: Automatic-reset switch cycles compressor off on high refrigerant pressure.
8. Liquid-line solenoid.
9. Low-Ambient Controller: Cycles condenser fan to permit operation down to 0 deg F (minus 18 deg C).
10. Low-Pressure Switch: Automatic-reset switch cycles compressor off on low refrigerant pressure.
11. PE mounting base.
12. Pre-charged and insulated suction and liquid tubing.
13. Sound Hood: Wraps around sound attenuation cover for compressor.
14. Thermostatic expansion valve.
15. Time-Delay Relay: Continues operation of evaporator fan after compressor shuts off.
16. Reversing valve.

H. Unit Casing: Galvanized steel, finished with baked enamel; with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Mount service valves, fittings, and gage ports on exterior of casing.

I. Capacities and Characteristics: See Drawings

2.2 COMPRESSOR AND CONDENSER UNITS, AIR COOLED, 6 TO 120 TONS (21 TO 422 kW)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carrier Corporation; a unit of United Technologies Corp.
2. Trane.
3. YORK; a Johnson Controls company.

B. Description: Factory assembled and tested, air cooled; consisting of casing, compressors, condenser coils, condenser fans and motors, and unit controls.

C. Compressor: Hermetic scroll compressor designed for service with crankcase sight glass, crankcase heater, and backseating service access valves on suction and discharge ports.

1. Capacity Control: Hot-gas bypass.

D. Refrigerant: R-407C, R-410A, or R-134a.

E. Condenser Coil: Seamless copper-tube, aluminum-fin coil, including subcooling circuit and backseating liquid-line service access valve. Factory pressure test coils, then dehydrate by drawing a vacuum and fill with a holding charge of nitrogen or refrigerant.

- F. Condenser Fans: Propeller-type vertical discharge; either directly or belt driven. Include the following:
1. Permanently lubricated, ball-bearing totally enclosed motors.
 2. Separate motor for each fan.
 3. Dynamically and statically balanced fan assemblies.
- G. Operating and safety controls include the following:
1. Manual-reset, high-pressure cutout switches.
 2. Automatic-reset, low-pressure cutout switches.
 3. Low-oil-pressure cutout switch.
 4. Compressor-winding thermostat cutout switch.
 5. Three-leg, compressor-overload protection.
 6. Control transformer.
 7. Magnetic contactors for compressor and condenser fan motors.
 8. Timer to prevent excessive compressor cycling.
- H. Accessories:
1. Electronic programmable thermostat to control compressor and condenser unit and evaporator fan.
 2. Low-Ambient Controller: Cycles condenser fan to permit operation down to **0 deg F (minus 18 deg C)** with time-delay relay to bypass low-pressure switch.
 3. Gage Panel: Package with refrigerant circuit suction and discharge gages.
 4. Hot-gas bypass kit.
 5. Part-winding-start timing relay, circuit breakers, and contactors.
 6. Reversing valve.
- I. Unit Casings: Designed for outdoor installation with weather protection for components and controls and with removable panels for required access to compressors, controls, condenser fans, motors, and drives. Additional features include the following:
1. Steel, galvanized or zinc coated, for exposed casing surfaces; treated and finished with manufacturer's standard paint coating.
 2. Perimeter base rail with forklift slots and lifting holes to facilitate rigging.
 3. Gasketed control panel door.
 4. Non-fused disconnect switch, factory mounted and wired, for single external electrical power connection.
 5. Condenser coil hail guard.
- J. Capacities and Characteristics: See Drawings

2.3 COMPRESSOR AND CONDENSER UNITS, WATER COOLED

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Carrier Corporation; a unit of United Technologies Corp.
 2. Trane.
 3. YORK; a Johnson Controls company.
- B. Description: Factory assembled and tested, consisting of compressors, water-cooled condensers, bases, and unit controls.

- C. Compressor: Hermetic or serviceable hermetic type; with oil pump, operating oil charge, and suction and discharge shutoff valves. Factory mounted on base using spring isolators. Include the following:
 - 1. Thermally protected compressor motor.
 - 2. Crankcase heater.
 - 3. Capacity control using cylinder unloading, suction pressure controlled and discharge pressure operated, designed for unloaded start.
- D. Refrigerant: R-407C, R-410A, or R-134a.
- E. Condenser: Single-pass, tube-in-tube, coaxial type; with seamless, integral-finned, copper tube and steel outer shell with water-regulating valve.
- F. Condenser: Multi-pass, shell-and-tube type; with replaceable, seamless, integral-finned copper tubes; positive-liquid sub-cooling circuit; pressure relief device; liquid-level test cock; purge connection; liquid-line shutoff valve; and angle valve for connection of water-regulating valve.
 - 1. Unit Construction: ASME stamped for refrigerant-side working pressure of 385 psig (2650 kPa) and water-side working pressure of 250 psig (1720 kPa).
- G. Condenser: Plate type, with brazed assembly of two end plates, one with threaded nozzles and pattern-embossed plates.
- H. Accessories:
 - 1. Discharge-line muffler.
 - 2. Gage panel containing gages for suction, discharge, and oil pressure.
 - 3. Electric solenoid cylinder unloaders.
 - 4. Pump-down relay package.
 - 5. Crankcase cover plates with equalizer connections.
- I. Controls: Factory-mounted and -wired panel with the following:
 - 1. Timer to prevent short cycling.
 - 2. High- and low-refrigerant-pressure safety controls.
 - 3. Power- and control-circuit terminal blocks.
 - 4. Compressor motor starter.
 - 5. Control-circuit on-off switch.
 - 6. Control-circuit fuse.
- J. Unit Casings: Galvanized steel, finished with baked enamel; with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Mount service valves, fittings, and gage ports on exterior of casing.
- K. Capacities and Characteristics: See Drawings

2.4 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.5 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate compressor and condenser units according to ARI 206/110.
- B. Energy Efficiency: Equal to or greater than prescribed by ASHRAE/IESNA 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings," Section 6, "Heating, Ventilating, and Air-Conditioning."
- C. Test and inspect shell and tube condensers according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- D. Testing Requirements: Factory test sound-power-level ratings according to ARI 270.

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 compressor and condenser units.
- B. Examine roughing-in for refrigerant piping systems to verify actual locations of piping connections before equipment installation.
- C. Examine walls, floors, and roofs for suitable conditions where compressor and condenser units will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install units level and plumb, firmly anchored in locations indicated.
- B. Install roof-mounting units on equipment supports specified in Section 077200 "Roof Accessories."
- C. Equipment Mounting:
 1. Install compressor and condenser units on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
 2. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
 3. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- D. Maintain manufacturer's recommended clearances for service and maintenance.

- E. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.

3.3 CONNECTIONS

- A. Comply with requirements for piping in other Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- C. Connect pre-charged refrigerant tubing to unit's quick-connect fittings. Install tubing so it does not interfere with access to unit. Install furnished accessories.
- D. Connect refrigerant piping to air-cooled compressor and condenser units; maintain required access to unit. Install furnished field-mounted accessories. Refrigerant piping and specialties are specified in Section 232300 "Refrigerant Piping."
- E. Connect refrigerant and condenser-water piping to water-cooled compressor and condenser units. Maintain clear tube removal space. Refrigerant piping and specialties are specified in Section 232300 "Refrigerant Piping" and condenser-water piping and specialties are specified in Section 221116 "Domestic Water Piping." Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties." Install shutoff valve and union or flange at each water supply connection; install balancing valve and union or flange at each return connection.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test. Certify compliance with test parameters.
 - 2. Leak Test: After installation, charge system with refrigerant and oil and test for leaks. Repair leaks, replace lost refrigerant and oil, and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor operation and unit operation, product capability, and compliance with requirements.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 5. Verify proper airflow over coils.
- C. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.
- D. Compressor and condenser units will be considered defective if they do not pass tests and inspections.

- E. Prepare test and inspection reports.

3.5 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 and perform the following:
 - a. Inspect for physical damage to unit casing.
 - b. Verify that access doors move freely and are weathertight.
 - c. Clean units and inspect for construction debris.
 - d. Verify that all bolts and screws are tight.
 - e. Adjust vibration isolation and flexible connections.
 - f. Verify that controls are connected and operational.
- B. Lubricate bearings on fan motors.
- C. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.
- D. Adjust fan belts to proper alignment and tension.
- E. Start unit according to manufacturer's written instructions and complete manufacturer's startup checklist.
- F. Measure and record airflow and air temperature rise over coils.
- G. Verify proper operation of condenser capacity control device.
- H. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.
- I. After startup and performance test, lubricate bearings.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain compressor and condenser units.

END OF SECTION 236200

SECTION 238126

SPLIT-SYSTEM AIR-CONDITIONERS

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 split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: One set(s) for each air-handling unit (MERV 10).

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance:
 - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
 - 2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.8 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period:
 - a. For Compressor: Five year(s) from date of Substantial Completion.
 - b. For Parts: Five year(s) from date of Substantial Completion.
 - c. For Labor: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. Daikin.
- 2. Fujitsu.
- 3. LG.
- 4. Mitsubishi Electric & Electronics USA, Inc.
- 5. Trane.
- 6. York: A Johnson Controls Company.

2.2 INDOOR UNITS (5 TONS OR LESS)

- A. Concealed Evaporator-Fan Components:

1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
3. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
4. Fan Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type.
 - b. Motor requirements:
 - 1) Comply with NEMA MG 1.
 - 2) Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 5500 feet above sea level.
 - 3) Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
 - c. Multi-tapped, multispeed with internal thermal protection and permanent lubrication.
 - d. Wiring Terminations: Connect motor to chassis wiring with plug connection.
5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
6. Filters: Permanent, cleanable.
7. Condensate Drain Pans:
 - a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
 - 1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
 - 2) Depth: A minimum of 2 inches deep.
 - b. Single-wall, stainless-steel sheet.
 - c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
 - 1) Minimum Connection Size: NPS 1.
 - d. Pan-Top Surface Coating: Asphaltic waterproofing compound.
 - e. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.
8. Air Filtration Section:
 - a. General Requirements for Air Filtration Section:
 - 1) Comply with NFPA 90A.
 - 2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.
 - 3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.

2.3 OUTDOOR UNITS (5 TONS OR LESS)

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - a. Compressor Type: Scroll.
 - b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
 - c. Refrigerant Charge: R-410A.
 - d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Low Ambient Kit: Permits operation down to 0 deg F.

2.4 PIPING

- A. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type L (B), annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
- B. Insulation
 1. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 2. Any insulation exposed to the elements or sunlight shall be uv resistant.

2.5 ACCESSORIES

- A. Thermostat: Low voltage with subbase to control compressor and evaporator fan.
 1. Compressor time delay.
 2. 24-hour time control of system stop and start.
 3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
 4. Fan-speed selection including auto setting.
- B. Automatic-reset timer to prevent rapid cycling of compressor.
- C. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
- D. Drain Hose: For condensate.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install refrigerant piping according to ASHRAE 15.
- D. 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.
- E. Install piping free of sags and bends.
- F. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- A. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps and double risers to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet (6 m) long.
 - 2. Roller hangers and spring hangers for individual horizontal runs 20 feet (6 m) or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for copper tubing with the following maximum spacing and minimum rod diameters:
 - 1. NPS 5/8 (DN 18): Maximum span, 60 inches (1500 mm); minimum rod, 1/4 inch (6.4 mm).
- D. Charge system using the following procedures:
 - 1. Install core in filter dryers after leak test but before evacuation.
 - 2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers (67 Pa). If vacuum holds for 12 hours, system is ready for charging.
 - 3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig (14 kPa).
 - 4. Charge system with a new filter-dryer core in charging line.
- E. Install sleeves for piping penetrations of walls, ceilings, and floors.
- F. Install sleeve seals for piping penetrations of concrete walls and slabs.

- G. Equipment Mounting:
 - 1. Provide isolation pads per details shown on plans.
- H. Install and connect pre-charged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.4 STARTUP SERVICE

- A. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126

SECTION 238239.19

WALL AND CEILING UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes wall and ceiling heaters with propeller fans and electric-resistance heating coils.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include details of anchorages and attachments to structure and to supported equipment.
 - 4. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
 - 5. Wiring Diagrams: Power, signal, and control wiring.
- C. Samples: For each exposed product and for each color and texture specified.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wall and ceiling unit heaters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Berko; Marley Engineered Products.
 2. Markel Products; TPI Corporation.
 3. Marley Engineered Products.
 4. QMark; Marley Engineered Products.
 5. Trane.

2.2 DESCRIPTION

- A. Assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.
- 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 CABINET

- A. Front Panel: Stamped-steel louver or Extruded-aluminum bar grille, with removable panels fastened with tamperproof fasteners.
- B. Finish: Baked enamel over baked-on primer with manufacturer's custom color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Surface-Mounted Cabinet Enclosure: Steel with finish to match cabinet.

2.4 COIL

- A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high-temperature protection. Provide integral circuit breaker for overcurrent protection.

2.5 FAN AND MOTOR

- A. Fan: Aluminum propeller directly connected to motor.
- B. Motor: Permanently lubricated, multispeed. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.6 CONTROLS

- A. Controls: Unit-mounted thermostat. Low-voltage relay with transformer kit.
- B. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive wall and ceiling unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical connections to verify actual locations before unit-heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall and ceiling unit heaters to comply with NFPA 90A.
- B. Install wall and ceiling unit heaters level and plumb.
- C. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

END OF SECTION 238239.19

SECTION 238316

RADIANT-HEATING HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes radiant-heating piping, including pipes, fittings, and piping specialties.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. PEX: Crosslinked polyethylene.
- C. PEX/AL/PEX: Crosslinked polyethylene/aluminum/crosslinked polyethylene.
- D. PTFE: Polytetrafluoroethylene plastic.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include data for piping, fittings, manifolds, specialties, and controls; include pressure and temperature ratings, oxygen-barrier performance, fire-performance characteristics, and water-flow and pressure-drop characteristics.
- B. Shop Drawings: Show piping layout and details drawn to scale, including valves, manifolds, controls, and support assemblies, and their attachments to building structure.
 - 1. Shop Drawing Scale: **1/4 inch = 1 foot (1:50)**.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) 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. Suspended ceiling components.
 - 2. Structural members to which radiant-heating piping will be attached.
 - 3. Items penetrating finished ceiling, including the following:

- a. Lighting fixtures.
- b. Air outlets and inlets.
- c. Speakers.
- d. Sprinklers.
- e. Access panels.

4. Perimeter moldings.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For radiant-heating piping valves and equipment to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PEX PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Uponor.
 2. Viega LLC.
 3. Warmboard, Inc.
 4. Watts Radiant; a Watts Water Technologies company.
 5. Zurn Industries, LLC.
 6. Roth
- B. Pipe Material: PEX plastic according to ASTM F 876.
- C. Oxygen Barrier: Limit oxygen diffusion through the tube to maximum 0.10 mg per cu. m/day at **104 deg F (40 deg C)** according to DIN 4726.
- D. Fittings: ASTM F 1807, metal insert and copper crimp rings.
- E. Pressure/Temperature Rating: Minimum **100 psig (690 kPa)** and **180 deg F (82 deg C)**.

2.2 PEX/AL/PEX PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Uponor.
 2. Viega LLC.
 3. Watts Radiant; a Watts Water Technologies company.
 4. Roth
- B. Pipe Material: PEX plastic bonded to the inside and outside of a welded aluminum tube according to ASTM F 1281.

- C. Oxygen Barrier: Limit oxygen diffusion through the pipe to maximum 0.10 mg per cu. m/day at 104 deg F (40 deg C) according to DIN 4726.
- D. Fittings: ASTM F 1974, metal insert fittings with split ring and compression nut (compression joint) or metal insert fittings with copper crimp rings (crimp joint).
- E. Flame-Spread and Smoke-Developed Indices: 25 and 50 or less, respectively, tested according to ASTM E 84.
- F. Pressure/Temperature Rating: Minimum 100 psig (690 kPa) and 210 deg F (99 deg C).

2.3 DISTRIBUTION MANIFOLDS

- A. Manifold: Minimum NPS 1 (DN 25), brass copper modular plastic or stainless steel.
- B. Main Shutoff Valves:
 1. Factory installed on supply and return connections.
 2. Two-piece body.
 3. Body: Brass or bronze.
 4. Ball: Chrome-plated bronze.
 5. Seals: PTFE.
 6. CWP Rating: 150 psig (1035 kPa).
 7. Maximum Operating Temperature: 225 deg F (107 deg C).
- C. Manual Air Vents:
 1. Body: Bronze.
 2. Internal Parts: Nonferrous.
 3. Operator: Key furnished with valve, or screwdriver bit.
 4. Inlet Connection: NPS 1/2 (DN 15).
 5. Discharge Connection: NPS 1/8 (DN 6).
 6. CWP Rating: 150 psig (1035 kPa).
 7. Maximum Operating Temperature: 225 deg F (107 deg C).
- D. Balancing Valves:
 1. Body: Plastic or bronze, ball or plug, or globe cartridge type.
 2. Ball or Plug: Brass or stainless steel.
 3. Globe Cartridge and Washer: Brass with EPDM composition washer.
 4. Seat: PTFE.
 5. Visual Flow Indicator: Flowmeter with visible indication in a clear plastic cap at top of valve.
 6. Differential Pressure Gage Connections: Integral seals for portable meter to measure loss across calibrated orifice.
 7. Handle Style: Lever or knob, with memory stop to retain set position if used for shutoff.
 8. CWP Rating: Minimum 125 psig (860 kPa).
 9. Maximum Operating Temperature: 250 deg F (121 deg C).
- E. Zone Control Valves:
 1. Body: Plastic or bronze, ball or plug, or globe cartridge type.
 2. Ball or Plug: Brass or stainless steel.
 3. Globe Cartridge and Washer: Brass with EPDM composition washer.

4. Seat: PTFE.
5. Actuator: Replaceable electric motor.
6. CWP Rating: Minimum 125 psig (860 kPa).
7. Maximum Operating Temperature: 250 deg F (121 deg C).

F. Thermometers:

1. Mount on supply and return connections.
2. Case: Dry type, metal or plastic, 2-inch (50-mm) diameter.
3. Element: Bourdon tube or other type of pressure element.
4. Movement: Mechanical, connecting element and pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Black metal.
7. Window: Plastic.
8. Connector: Rigid, back type.
9. Thermal System: Liquid- or mercury-filled bulb in copper-plated steel, aluminum, or brass stem.
10. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

G. Mounting Brackets: Copper, or plastic- or copper-clad steel, where in contact with manifold.

2.4 PIPING SPECIALTIES

A. Cable Ties:

1. Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.
2. Minimum Width: 1/8 inch (3 mm).
3. Tensile Strength: 20 lb (9 kg), minimum.
4. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).

B. Floor Mounting Staples:

1. Steel, with corrosion-resistant coating and smooth finish without sharp edges.
2. Minimum Thickness: 3/32 inch (2.4 mm).
3. Width: Minimum, wider than tubing.

C. Floor Mounting Clamps:

1. Two bolts, steel, with corrosion-resistant coating and smooth finish without sharp edges.
2. Minimum Thickness: 3/32 inch (2.4 mm).
3. Width: Minimum, wider than tubing.

D. Floor Mounting Tracks:

1. Aluminum or plastic channel track with smooth finish and no sharp edges.
2. Minimum Thickness: 1/16 inch (1.6 mm).
3. Slot Width: Snap fit to hold tubing.
4. Slot Spacing: 2-inch (50-mm) intervals.

E. Channeled Subfloor:

1. Plywood, APA-rated subfloor panel, composed of premium, tongue-and-groove, seven-layer, Douglas fir structural subfloor panels.

2. Particleboard manufactured to comply with Federal Housing Authority standards of less than 0.3-ppm formaldehyde.
3. Clad panel with minimum **0.025-inch- (0.635-mm-)** thick aluminum recessed in the grooves sized to maintain contact with radiant piping.

F. Modular Interlocking Blocks:

1. Polypropylene snap-together blocks with grooves to support piping.
2. Galvanized sheet metal or aluminum emission plates.
3. Natural mineralboard cover panel.

G. Heat-Emission Plates:

1. Formed aluminum suitable for radiant-heating piping.
2. Minimum Thickness: **1/16 inch (1.6 mm)**.
3. Slot Width: Snap fit to maintain pressure fit on tubing.

2.5 CONTROLS

A. Temperature-control devices and sequence of operations are specified in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."

B. Wall-Mounted Thermostat:

1. Minimum temperature range from **50 to 90 deg F (10 to 32 deg C)**.
2. Manually operated with on-off switch.
3. Day and night setback and clock program with minimum four periods per day.
4. Operate pumps or open zone control valves if room temperature falls below the thermostat setting, and stop pumps or close zone control valves when room temperature rises above the thermostat setting.

C. Heated-Panel Thermostat:

1. Remote bulb unit with adjustable temperature range from **50 to 90 deg F (10 to 32 deg C)**.
2. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected pump or zone control valve.
3. Remote bulb on capillary tube, resistance temperature device, or thermistor for directly sensing radiant-panel temperature.
4. Stop pump or close zone control valves if heated-panel thermostat setting is exceeded.
5. Corrosion-resistant, waterproof control enclosure.

D. Heated-Panel Thermostat with Outdoor Temperature Reset:

1. Remote bulb unit with adjustable temperature range from **50 to 90 deg F (10 to 32 deg C)**.
2. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected pump or zone control valve.
3. Remote bulb on capillary tube, resistance temperature device, or thermistor for directly sensing radiant-panel and outdoor-air temperature.
4. Operate zone control valves to reset supply-water temperature inversely with outdoor-air temperature as follows:

- a. Low outdoor-air temperature, zero deg F (minus 18 deg C) with high supply-water temperature 110 deg F (43 deg C).
 - b. High outdoor-air temperature, 60 deg F (16 deg C) with low supply-water temperature 70 deg F (21 deg C).
- 5. Corrosion-resistant, waterproof control enclosure.
- E. Precipitation and Temperature Sensor:
 - 1. Automatic control with manual on, automatic, and standby/reset switch.
 - 2. Precipitation and temperature sensors shall sense the surface conditions of pavement and shall be programmed to operate pump and zone control valves as follows:
 - a. Temperature Span: 34 to 44 deg F (1 to 7 deg C).
 - b. Adjustable Delay Off Span: 30 to 90 minutes.
 - c. Start Pump or Open Zone Control Valves: Following two-minute delay if ambient temperature is below set point and precipitation is detected.
 - d. Stop Pump or Close Zone Control Valves: On detection of a dry surface plus time delay.
 - 3. Corrosion-proof and waterproof enclosure suitable for outdoor mounting, for controls and precipitation and temperature sensors.
 - 4. Minimum 30-A contactor to start pump and open valves.
 - 5. Precipitation sensor shall be mounted in pavement.
 - 6. Provide relay with contacts to indicate operational status, on or off, for interface with central HVAC control-system workstation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and substrates to receive radiant-heating piping for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Ensure that surfaces and pipes in contact with radiant-heating piping are free of burrs and sharp protrusions.
 - 2. Ensure that surfaces and substrates are level and plumb.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings or coordination drawings.
- B. Install radiant-heating piping continuous from the manifold through the heated panel and back to the manifold without piping joints in heated panels.
- C. Connect radiant piping to manifold in a reverse-return arrangement.

- D. Do not bend pipes in radii smaller than manufacturer's minimum bend radius dimensions.
- E. Install manifolds in accessible locations, or install access panels to provide maintenance access as required in Section 083113 "Access Doors and Frames."
- F. Comply with requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties" for pipes and connections to hydronic systems and for glycol-solution fill requirements.
- G. Fire- and Smoke-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials according to Section 078413 "Penetration Firestopping."
- H. Piping in Exterior Pavement or Concrete:
 - 1. Provide with Viega rapid grid insulation and pipe fastener or R-5 foam insulation under entire radiant heating zone.
 - 2. Secure piping in concrete floors by attaching pipes to reinforcement using cable ties. If no reinforcement is needed for concrete, provide wire mesh for attaching piping.
 - 3. Space cable ties a maximum of **18 inches (457 mm)** o.c. and at center of turns or bends if Rapid Grid is not used.
 - 4. Maintain **3-inch (75-mm)** minimum cover.
 - 5. Install a sleeve of **3/8-inch- (9.5-mm-)** thick, foam-type insulation or PE pipe around tubing and extending for a minimum of **10 inches (250 mm)** on each side of slab joints to protect the tubing passing through expansion or control joints. Anchor sleeve to slab form at control joints to provide maximum clearance for saw cut.
 - 6. Maintain minimum **40-psig (275-kPa)** pressure in piping during concrete placement and continue for 24 hours after placement.
- I. Piping in Interior Reinforced-Concrete Floors:
 - 1. Secure piping in concrete floors by attaching pipes to reinforcement using cable ties.
 - 2. Space cable ties a maximum of **18 inches (457 mm)** o.c. and at center of turns or bends.
 - 3. Maintain **2-inch (50-mm)** minimum cover.
 - 4. Install a sleeve of **3/8-inch- (9.5-mm-)** thick, foam-type insulation or PE pipe around tubing and extending for a minimum of **10 inches (250 mm)** on each side of slab joints to protect the tubing passing through expansion or control joints. Anchor sleeve to slab form at control joints to provide maximum clearance for saw cut.
 - 5. Maintain minimum **40-psig (275-kPa)** pressure in piping during concrete placement and continue for 24 hours after placement.
- J. Piping in Level Fill Concrete Floors (Not Reinforced):
 - 1. Secure piping in concrete floors by attaching pipes to subfloor using tracks, clamps, or staples.
 - 2. Space tracks, clamps, or staples a maximum of **18 inches (457 mm)** o.c. and at center of turns or bends.
 - 3. Maintain **3/4-inch (19-mm)** minimum cover.
 - 4. Install a sleeve of **3/8-inch- (9.5-mm-)** thick, foam-type insulation or PE pipe around tubing and extending for a minimum of **10 inches (250 mm)** on each side of slab joints to protect the tubing passing through expansion or control joints. Anchor sleeve to slab form at control joints to provide maximum clearance for saw cut.
 - 5. Maintain minimum **40-psig (275-kPa)** pressure in piping during the concrete pour and continue for 24 hours during curing.

K. Piping in Ceiling:

1. Secure piping by attaching pipes to ceiling substrate using clamps or staples.
2. Space clamps or staples a maximum of **18 inches (457 mm)** o.c. and at center of turns or bends.
3. Maintain **1-1/2-inch (38-mm)** minimum plaster cover.
4. Maintain minimum **40-psig (275-kPa)** pressure in piping during the plaster application and continue for 24 hours during curing.

L. Piping in Subfloor:

1. Secure piping by laying in subfloor channels or modular interlocking blocks.
2. Use straight channel panels or blocks in the center and curved channel panels or blocks at the ends.
3. Finish floor with mineral board panel cover or finished floor surface.

M. Piping below Wood Floor:

1. Secure piping by attaching pipes to subfloor using heat-emission plates, clamps, or staples.
2. Space heat-emission plates, clamps, or staples a maximum of **4 inches (100 mm)** o.c. and at center of turns or bends.
3. Install heat-emission plates on underside of wood subfloor with maximum space between plates, as noted above, to maintain pipe contact with floor.

N. Revise locations and elevations from those indicated as required to suit field conditions and ensure integrity of piping and as approved by Architect.

O. After system balancing has been completed, mark balancing valves to permanently indicate final position.

P. Perform the following adjustments before operating the system:

1. Open valves to fully open position.
2. Check operation of automatic valves.
3. Set temperature controls so all zones call for full flow.
4. Purge air from piping.

Q. After concrete or plaster heating panel has cured as recommended by concrete or plaster supplier, operate radiant-heating system as follows:

1. Start system heating at a maximum of **10 deg F (6 deg C)** above the ambient radiant-panel temperature and increase **10 deg F (6 deg C)** each following day until design temperature is achieved.
2. For freeze protection, operate at a minimum of **60 deg F (16 deg C)** supply-water temperature.

3.3 FIELD QUALITY CONTROL

A. Prepare radiant-heating piping for testing as follows:

1. Open all isolation valves and close bypass valves.
2. Open and verify operation of zone control valves.
3. Flush with clean water and clean strainers.

- B. Perform the following tests and inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Subject piping to hydrostatic test pressure that is not less than 1.5 times the design pressure but not more than 100 psig (690 kPa). Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Radiant-heating piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Protect hydronic piping system from damage during construction.

END OF SECTION 238316

Table of Contents: Division 26, 27, & 28

COVER PAGE

DIVISION 26: ELECTRICAL

SECTION	260500	COMMON WORK RESULTS FOR ELECTRICAL
	260519	LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
	260526	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
	260529	HANGERS & SUPPORTS FOR ELECTRICAL SYSTEMS
	260533	RACEWAYS & BOXES FOR ELECTRICAL SYSTEMS
	260536	CABLE TRAYS FOR ELECTRICAL SYSTEMS
	260548	VIBRATION & SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS
	260553	IDENTIFICATION OF ELECTRICAL SYSTEMS
	260572	OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY
	260573	OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY
	260574	OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY
	260923	LIGHTING CONTROL DEVICES
	260943	NETWORK LIGHTING CONTROLS
	262413	SWITCHBOARDS
	262416	PANELBOARDS
	262726	WIRING DEVICES
	262726.1	WIRING DEVICE SCHEDULE
	262813	FUSES
	262816	ENCLOSED SWITCHES AND CIRCUIT BREAKERS
	262913	ENCLOSED CONTROLLERS
	263213	ENGINE GENERATORS
	263600	TRANSFER SWITCHES
	264313	SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS
	265100	INTERIOR LIGHTING
	265600	EXTERIOR LIGHTING

DIVISION 27: COMMUNICAITONS

SECTION	271100	TELECOMMUNICATIONS PATHWAYS AND SPACES
	271300	COMMUNICATION BACKBONE CABLING
	271500	COMMUNICATIONS HORIZONTAL CABLING

DIVISION 28: ELECTRONIC SAFETY AND SECURITY

SECTION	281300	ACCESS CONTROLS
	281316	SECURITY AND DATABASE MANAGEMENT SYSTEM
	283111	DIGITAL ADDRESSABLE FIRE ALARM SYSTEM

END OF TABLE OF CONTENTS

SECTION 260500

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Electrical equipment coordination and installation. Requirement for a preconstruction meeting.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Grout.
5. Common electrical installation requirements.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For sleeve seals.

1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- E. Preconstruction Meeting: Electrical Engineer will schedule and conduct a preconstruction meeting before starting construction, at a time convenient to Owner Architect, and Electrical Engineer, but no later than 7 days after execution of the Agreement.
 - 1. Attendees: Authorized representatives of Owner, Government's Project Manager, Architect, Electrical Engineer, Contractor and its superintendent; Electrical Contractor; 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. Tentative construction schedule.
 - b. Phasing.
 - c. Critical work sequencing and long-lead items.
 - d. Designation of key personnel and their duties.
 - e. Procedures for processing field decisions and Change Orders.
 - f. Procedures for RFIs.
 - g. Procedures for testing and inspecting.
 - h. Submittal procedures.
 - i. Preparation of record documents.
 - j. Use of the premises.
 - k. Work restrictions.
 - l. Working hours.
 - m. Owner's occupancy requirements.
 - n. Responsibility for temporary facilities and controls.
 - o. Procedures for disruptions and shutdowns.
 - p. Parking availability.
 - q. Office, work, and storage areas.
 - r. Equipment deliveries and priorities.
 - s. First aid.
 - t. Security.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- B. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).

- b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 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. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 3. Pressure Plates: Stainless steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors **2 inches (50 mm)** above finished floor level.
- G. Size pipe sleeves to provide **1/4-inch (6.4-mm)** annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for **1-inch (25-mm)** annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for **1-inch (25-mm)** annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION

SECTION 260519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
 - 3. Sleeves and sleeve seals for cables.
- B. Related Sections include the following:
 - 1. Division 27 Section "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For testing agency.
- C. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alcan Products Corporation; Alcan Cable Division.
 - 2. American Insulated Wire Corp.; a Leviton Company.
 - 3. General Cable Corporation.
 - 4. Senator Wire & Cable Company.
 - 5. Southwire Company.
- B. Copper Conductors: Comply with NEMA WC 70.
- C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN.

2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Hubbell Power Systems, Inc.
 - 3. O-Z/Gedney; EGS Electrical Group LLC.
 - 4. 3M; Electrical Products Division.
 - 5. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SLEEVES FOR CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.4 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex Co.
 - 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
 - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 2. Pressure Plates: Stainless steel. Include two for each sealing element.
 - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-THWN, single conductors in raceway.
- B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-THWN, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- E. Feeders Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway.
- F. Exposed Branch Circuits, Including in Crawlspace: Type THHN-THWN, single conductors in raceway.

- G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway. Metal-clad cable, type MC may be used in branch circuits where concealed in ceilings and walls.
- H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- I. Branch Circuits Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway.
- J. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- K. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- L. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
- F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least **12 inches (300 mm)** of slack.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
 - 1. For sleeve rectangle perimeter less than **50 inches (1270 mm)** and no side greater than **16 inches (400 mm)**, thickness shall be **0.052 inch (1.3 mm)**.
 - 2. For sleeve rectangle perimeter equal to, or greater than, **50 inches (1270 mm)** and 1 or more sides equal to, or greater than, **16 inches (400 mm)**, thickness shall be **0.138 inch (3.5 mm)**.
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both wall surfaces.
- G. Extend sleeves installed in floors **2 inches (50 mm)** above finished floor level.
- H. Size pipe sleeves to provide **1/4-inch (6.4-mm)** annular clear space between sleeve and cable unless sleeve seal is to be installed.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 07 Section "Joint Sealants."
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 07 Section "Penetration Firestopping."
- L. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.
- M. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for **1-inch (25-mm)** annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- N. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for **1-inch (25-mm)** annular clear space between cable and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground exterior-wall penetrations.

- B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.
 - a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
 - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- C. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

SECTION 260526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment, plus the following special applications:
 1. Common ground bonding with lightning protection system.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
 1. Test wells.
 2. Ground rods.
 3. Ground rings.
 4. Grounding arrangements and connections for separately derived systems.
 5. Grounding for sensitive electronic equipment.
- C. Qualification Data: For testing agency and testing agency's field supervisor.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:
 - a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
 - b. Include recommended testing intervals.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 1. Solid Conductors: ASTM B 3.
 2. Stranded Conductors: ASTM B 8.
 3. Tinned Conductors: ASTM B 33.
 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
- C. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 2 inches (6 by 50 mm) in cross section, unless otherwise indicated; with insulators.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, sectional type; 3/4 inch by 10 feet (19 mm by 3 m) in diameter.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least **24 inches (600 mm)** below grade.
 - 2. Duct-Bank Grounding Conductor: Bury **12 inches (300 mm)** above duct bank when indicated as part of duct-bank installation.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus on insulated spacers **1 inch (25 mm)**, minimum, from wall **6 inches (150 mm)** above finished floor, unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, down to specified height above floor, and connect to horizontal bus.
- E. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so **4 inches (100 mm)** will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from **2 inches (50 mm)** above to **6 inches (150 mm)** below concrete. Seal floor opening with waterproof, nonshrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.
 - 6. Flexible raceway runs.
 - 7. Armored and metal-clad cable runs.
 - 8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
 - 9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
 - 10. Communications Cable Tray
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- G. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
 - 1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch (6-by-50-by-300-mm) grounding bus.
 - 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- H. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.4 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are **2 inches (50 mm)** below finished floor or final grade, unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
 - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Division 26 Section "Underground Ducts and Raceways for Electrical Systems," and shall be at least **12 inches (300 mm)** deep, with cover.
 - 1. Test Wells: Install at least one test well for each service, unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- F. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

- G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
- H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than **60 feet (18 m)** apart.
- I. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.
 - 1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
 - 2. Bury ground ring not less than **24 inches (600 mm)** from building foundation.
- J. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, using a minimum of **20 feet (6 m)** of bare copper conductor not smaller than No. 2/0 AWG.
 - 1. If concrete foundation is less than **20 feet (6 m)** long, coil excess conductor within base of foundation.
 - 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to grounding electrode external to concrete.

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 - 3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- B. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
 - 2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
 - 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 - 4. Substations and Pad-Mounted Equipment: 5 ohms.
 - 5. Manhole Grounds: 10 ohms.

- C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 260529

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.
- B. Related Sections include the following:
 - 1. Division 26 Section "Vibration And Seismic Controls For Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze hangers. Include Product Data for components.
 - 2. Steel slotted channel systems. Include Product Data for components.
 - 3. Nonmetallic slotted channel systems. Include Product Data for components.
 - 4. Equipment supports.
- C. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - g. Wesanco, Inc.
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.

4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 5. Channel Dimensions: Selected for applicable load criteria.
 6. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. Fabco Plastics Wholesale Limited.
 - d. Seasafe, Inc.
 7. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
 8. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
 9. Rated Strength: Selected to suit applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
 2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacing is less than stated in NFPA 70. Minimum rod size shall be **1/4 inch (6 mm)** in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for **1-1/2-inch (38-mm)** and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus **200 lb (90 kg)**.

- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
1. To Wood: Fasten with lag screws or through bolts.
 2. To New Concrete: Bolt to concrete inserts.
 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 4. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 5. To Light Steel: Sheet metal screws.
 6. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base.
 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 260533

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
 - 1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. EPDM: Ethylene-propylene-diene terpolymer rubber.
- D. FMC: Flexible metal conduit.
- E. IMC: Intermediate metal conduit.
- F. LFMC: Liquidtight flexible metal conduit.
- G. LFNC: Liquidtight flexible nonmetallic conduit.
- H. NBR: Acrylonitrile-butadiene rubber.
- I. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Custom enclosures and cabinets.

2. For handholes and boxes for underground wiring, including the following:
 - a. Duct entry provisions, including locations and duct sizes.
 - b. Frame and cover design.
 - c. Grounding details.
 - d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
 - e. Joint details.
- C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 1. Structural members in the paths of conduit groups with common supports.
 2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.
- D. Manufacturer Seismic Qualification Certification: Submit certification that enclosures and cabinets and their mounting provisions, including those for internal components, will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the cabinet or enclosure will remain in place without separation of any parts when subjected to the seismic forces specified."
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Qualification Data: For professional engineer and testing agency.
- F. Source quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. AFC Cable Systems, Inc.
 2. Alflec Inc.

3. Allied Tube & Conduit; a Tyco International Ltd. Co.
 4. Anamet Electrical, Inc.; Anaconda Metal Hose.
 5. Electri-Flex Co.
 6. Manhattan/CDT/Cole-Flex.
 7. Maverick Tube Corporation.
 8. O-Z Gedney; a unit of General Signal.
 9. Wheatland Tube Company.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. IMC: ANSI C80.6.
- D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
1. Comply with NEMA RN 1.
 2. Coating Thickness: 0.040 inch (1 mm), minimum.
- E. EMT: ANSI C80.3.
- F. FMC: Zinc-coated steel.
- G. LFMC: Flexible steel conduit with PVC jacket.
- H. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
 2. Fittings for EMT: Steel or die-cast, set-screw or compression type.
 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
- I. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

- A. 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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFC Cable Systems, Inc.
 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
 3. Arnco Corporation.
 4. CANTEX Inc.
 5. CertainTeed Corp.; Pipe & Plastics Group.
 6. Condux International, Inc.
 7. ElecSYS, Inc.
 8. Electri-Flex Co.
 9. Lamson & Sessions; Carlon Electrical Products.
 10. Manhattan/CDT/Cole-Flex.

11. RACO; a Hubbell Company.
12. Thomas & Betts Corporation.

- C. ENT: NEMA TC 13.
- D. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.
- E. LFNC: UL 1660.
- F. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.
- G. Fittings for LFNC: UL 514B.

2.3 OPTICAL FIBER/COMMUNICATIONS CABLE RACEWAY AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Arnco Corporation.
 2. Endot Industries Inc.
 3. IPEX Inc.
 4. Lamson & Sessions; Carlon Electrical Products.
- B. Description: Comply with UL 2024; flexible type, approved for plenum installation.

2.4 METAL WIREWAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Cooper B-Line, Inc.
 2. Hoffman.
 3. Square D; Schneider Electric.
- B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 3R, unless otherwise indicated.
- C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged type.
- E. Finish: Manufacturer's standard enamel finish.

2.5 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Thomas & Betts Corporation.
 - b. Walker Systems, Inc.; Wiremold Company (The).
 - c. Wiremold Company (The); Electrical Sales Division.
- B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Butler Manufacturing Company; Walker Division.
 - b. Enduro Systems, Inc.; Composite Products Division.
 - c. Hubbell Incorporated; Wiring Device-Kellems Division.
 - d. Lamson & Sessions; Carlon Electrical Products.
 - e. Panduit Corp.
 - f. Walker Systems, Inc.; Wiremold Company (The).
 - g. Wiremold Company (The); Electrical Sales Division.

2.6 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 - 2. EGS/Appleton Electric.
 - 3. Erickson Electrical Equipment Company.
 - 4. Hoffman.
 - 5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
 - 6. O-Z/Gedney; a unit of General Signal.
 - 7. RACO; a Hubbell Company.
 - 8. Robroy Industries, Inc.; Enclosure Division.
 - 9. Scott Fetzer Co.; Adalet Division.
 - 10. Spring City Electrical Manufacturing Company.
 - 11. Thomas & Betts Corporation.
 - 12. Walker Systems, Inc.; Wiremold Company (The).
 - 13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
- B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- D. Metal Floor Boxes: Cast metal, fully adjustable, rectangular.
- E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- F. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized, cast iron with gasketed cover.
- G. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
- 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
- H. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Description: Comply with SCTE 77.

1. Color of Frame and Cover: Gray.
2. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC." "TELEPHONE."
6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
7. Handholes **12 inches wide by 24 inches long (300 mm wide by 600 mm long)** and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. CDR Systems Corporation.
 - d. NewBasis.

C. Fiberglass Handholes and Boxes with Polymer-Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester-resin enclosure joined to polymer-concrete top ring or frame.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. Christy Concrete Products.
 - d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carson Industries LLC.
 - b. Christy Concrete Products.
 - c. Nordic Fiberglass, Inc.

2.8 SLEEVES FOR RACEWAYS

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.9 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex Co.
 - 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
 - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 2. Pressure Plates: Stainless steel. Include two for each sealing element.
 - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.10 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 - 1. Tests of materials shall be performed by a independent testing agency.
 - 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 - 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: Rigid steel conduit.
2. Concealed Conduit, Aboveground: Rigid steel or IMC conduit.
3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Includes raceways in the following locations:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: Rigid steel conduit.
7. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical fiber/communications cable raceway.
8. Raceways for Optical Fiber or Communications Cable Risers in Vertical Shafts: Riser-type, optical fiber/communications cable raceway.
9. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: Riser-type, optical fiber/communications cable raceway Plenum-type, optical fiber/communications cable raceway.
10. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.

C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits in contact with concrete.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

- B. Keep raceways at least **6 inches (150 mm)** away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- H. Raceways Embedded in Slabs:
 - 1. Run conduit larger than **1-inch (27-mm)** trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Change from ENT to RNC, Type EPC-40-PVC, rigid steel conduit, or IMC before rising above the floor.
- I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than **200-lb (90-kg)** tensile strength. Leave at least **12 inches (300 mm)** of slack at each end of pull wire.
- L. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:
 - 1. **3/4-Inch (19-mm)** Trade Size and Smaller: Install raceways in maximum lengths of **50 feet (15 m)**.
 - 2. **1-Inch (25-mm)** Trade Size and Larger: Install raceways in maximum lengths of **75 feet (23 m)**.
 - 3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- M. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.

2. Where otherwise required by NFPA 70.
- N. Flexible Conduit Connections: Use maximum of **72 inches (1830 mm)** of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- O. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.
- P. Set metal floor boxes level and flush with finished floor surface.
- Q. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than **6 inches (150 mm)** in nominal diameter.
2. Install backfill as specified in Division 31 Section "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within **12 inches (300 mm)** of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with **3 inches (75 mm)** of concrete.
 - b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of **60 inches (1500 mm)** from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
6. Warning Planks: Bury warning planks approximately **12 inches (300 mm)** above direct-buried conduits, placing them **24 inches (600 mm)** o.c. Align planks along the width and along the centerline of conduit.

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from **1/2-inch (12.5-mm)** sieve to **No. 4 (4.75-mm)** sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures **1 inch (25 mm)** above finished grade.
- D. Install handholes and boxes with bottom below the frost line, below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.
- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
 - 1. For sleeve cross-section rectangle perimeter less than **50 inches (1270 mm)** and no side greater than **16 inches (400 mm)**, thickness shall be **0.052 inch (1.3 mm)**.
 - 2. For sleeve cross-section rectangle perimeter equal to, or greater than, **50 inches (1270 mm)** and 1 or more sides equal to, or greater than, **16 inches (400 mm)**, thickness shall be **0.138 inch (3.5 mm)**.
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both surfaces of walls.
- G. Extend sleeves installed in floors **2 inches (50 mm)** above finished floor level.
- H. Size pipe sleeves to provide **1/4-inch (6.4-mm)** annular clear space between sleeve and raceway unless sleeve seal is to be installed or unless seismic criteria require different clearance.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping."
- L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.
- M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground, exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.8 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 260536

CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes continuous, rigid, welded steel wire mesh cable management system (Cable Tray) and accessories

1.3 SUBMITTALS

- A. Product Data: Include data indicating dimensions and finishes for each type of cable tray indicated.
- B. Shop Drawings: For each type of cable tray.
 - 1. Show fabrication and installation details of cable tray, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.
 - 2. Seismic-Restraint Details: Signed and sealed by a qualified professional engineer, licensed in the state where Project is located, who is responsible for their preparation.
 - a. Design Calculations: Calculate requirements for selecting seismic restraints.
 - b. Detail fabrication, including anchorages and attachments to structure and to supported cable trays.
- C. Coordination Drawings: Floor plans and sections, drawn to scale. Include scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements. Show the following:
 - 1. Vertical and horizontal offsets and transitions.
 - 2. Clearances for access above and to side of cable trays.
 - 3. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For cable trays to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain cable tray components through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Steel cable tray, hot dip galvanized after fabrication, may be stored outside without cover, but shall be loosely stacked, elevated off the ground, and ventilated to prevent staining during storage.
- B. Store indoors to prevent water or other foreign materials from staining or adhering to cable tray. Unpack and dry wet materials before storage.
- C. Steel, mill galvanized cable tray shall be stored in a well-ventilated, dry location. Unpack and dry wet materials before storage.
- D. Cable tray shall be stored indoors. Protect cable tray from scratching and marring of finish. Unpack and dry wet materials before storage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cablofil
 - 2. Chatsworth
 - 3. Cooper B-Line, Inc.
 - 4. GS Metals Corp.; Flextray.

2.2 MATERIALS AND FINISHES

- A. Cable Trays, Fittings, and Accessories: Steel, complying with NEMA VE 1.
 - 1. Hot-dip galvanized after fabrication, complying with ASTM A 123/A 123M, Class B2; with chromium-zinc, ASTM F 1136, hardware.
- B. Sizes and Configurations: Refer to the Cable Tray Schedule on Drawings for specific requirements for types, materials, sizes, and configurations.
 - 1. Center-hanger supports may not be used.

2.3 SIZES AND CONFIGURATIONS

- A. Accessible Ceiling:
 - 1. Width: 18 inches
 - 2. Inside Depth: 4 inches
 - 3. Mesh 2 x 4 inches
 - 4. Wire Diameter: .177 inches minimum.

2.4 CABLE TRAY ACCESSORIES

- A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
- B. Barrier Strips: Same materials and finishes as cable tray.
- C. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.5 SOURCE QUALITY CONTROL

- A. Perform design and production tests according to NEMA VE 1.

PART 3 - EXECUTION

3.1 CABLE TRAY INSTALLATION

- A. Comply with recommendations in NEMA VE 2. Install as a complete system, including all necessary fasteners, hold-down clips, splice-plate support systems, barrier strips, hinged horizontal and vertical splice plates, elbows, reducers, tees, and crosses.
- B. Remove burrs and sharp edges from cable trays.
- C. Fasten cable tray supports to building structure and install seismic restraints.
 - 1. Design each fastener and support to carry load indicated by seismic requirements and to comply with seismic-restraint details according to Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
 - 2. Place supports so that spans do not exceed maximum spans on schedules.
 - 3. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
 - 4. Support bus assembly to prevent twisting from eccentric loading.
 - 5. Manufacture center-hung support, designed for 60 percent versus 40 percent eccentric loading condition, with a safety factor of 3.
 - 6. Locate and install supports according to NEMA VE 1.
- D. Make connections to equipment with flanged fittings fastened to cable tray and to equipment. Support cable tray independent of fittings. Do not carry weight of cable tray on equipment enclosure.
- E. Install expansion connectors where cable tray crosses building expansion joint and in cable tray runs that exceed dimensions recommended in NEMA VE 1. Space connectors and set gaps according to applicable standard.
- F. Make changes in direction and elevation using standard fittings.
- G. Make cable tray connections using standard fittings.
- H. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."
- I. Sleeves for Future Cables: Install capped sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.
- J. Workspace: Install cable trays with enough space to permit access for installing cables.
- K. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600, 5000, and 15 000 V.
- L. After installation of cable trays is completed, install warning signs in visible locations on or near cable trays.

3.2 CABLE INSTALLATION

- A. Install cables only when cable tray installation has been completed and inspected.
- B. Fasten cables on horizontal runs with cable clamps or cable ties as recommended by NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.
- C. On vertical runs, fasten cables to tray every **18 inches (457 mm)**. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.
- D. In existing construction, remove inactive or dead cables from cable tray.

3.3 CONNECTIONS

- A. Ground cable trays according to manufacturer's written instructions.
- B. Install an insulated equipment grounding conductor with cable tray, in addition to those required by NFPA 70.

3.4 FIELD QUALITY CONTROL

- A. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements. Perform the following field quality-control survey:
 - 1. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable tray, vibration, and thermal expansion and contraction conditions, which may cause or have caused damage.
 - 2. Verify that the number, size, and voltage of cables in cable tray do not exceed that permitted by NFPA 70. Verify that communication or data-processing circuits are separated from power circuits by barriers.
 - 3. Verify that there is no intrusion of such items as pipe, hangers, or other equipment that could damage cables.
 - 4. Remove deposits of dust, industrial process materials, trash of any description, and any blockage of tray ventilation.
 - 5. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
 - 6. Check for missing or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
 - 7. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable tray.
- B. Report results in writing.

3.5 PROTECTION

- A. Protect installed cable trays.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
 - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by cable tray manufacturer.
 - 3. Install temporary protection for cables in open trays to protect exposed cables from falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials until the risk of damage is over.

END OF SECTION

SECTION 260548

VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Isolation pads.
2. Spring isolators.
3. Restrained spring isolators.
4. Channel support systems.
5. Restraint cables.
6. Hanger rod stiffeners.
7. Anchorage bushings and washers.

- B. Related Sections include the following:

1. Division 26 Section "Hangers And Supports For Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 DEFINITIONS

- A. The IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading: Coordinate all seismic performance requirements with structural engineer.

1.5 SUBMITTALS

- A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
 3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.
- B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators and seismic restraints.
 - a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other Division 26 Sections for equipment mounted outdoors.
 2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
 3. Field-fabricated supports.
 4. Seismic-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
- C. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.
- D. Welding certificates.
- E. Qualification Data: For professional engineer and testing agency.
- F. Field quality-control test reports.
- 1.6 QUALITY ASSURANCE
- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
- E. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ace Mountings Co., Inc.
 - 2. Amber/Booth Company, Inc.
 - 3. California Dynamics Corporation.
 - 4. Isolation Technology, Inc.
 - 5. Kinetics Noise Control.
 - 6. Mason Industries.
 - 7. Vibration Eliminator Co., Inc.
 - 8. Vibration Isolation.
 - 9. Vibration Mountings & Controls, Inc.
- B. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
 - 1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 - 2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.
 - 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.2 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amber/Booth Company, Inc.
 2. California Dynamics Corporation.
 3. Cooper B-Line, Inc.; a division of Cooper Industries.
 4. Hilti Inc.
 5. Loos & Co.; Seismic Earthquake Division.
 6. Mason Industries.
 7. TOLCO Incorporated; a brand of NIBCO INC.
 8. Unistrut; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- D. Restraint Cables: ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Do not weld stiffeners to rods.
- F. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.
- G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.
- H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- I. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- J. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.3 FACTORY FINISHES

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1. Powder coating on springs and housings.
 - 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
 - 3. Baked enamel or powder coat for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment and Hanger Restraints:
 - 1. Install restrained isolators on electrical equipment.
 - 2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
 - 3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

- C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- D. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 - 4. Test at least four Insert number of each type and size of installed anchors and fasteners selected by Architect.
 - 5. Test to 90 percent of rated proof load of device.
 - 6. Measure isolator restraint clearance.
 - 7. Measure isolator deflection.
 - 8. Verify snubber minimum clearances.
 - 9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- C. Remove and replace malfunctioning units and retest as specified above.

- D. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Adjust isolators after isolated equipment is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION

SECTION 260553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Identification for raceway and metal-clad cable.
 - 2. Identification for conductors and communication and control cable.
 - 3. Underground-line warning tape.
 - 4. Warning labels and signs.
 - 5. Instruction signs.
 - 6. Equipment identification labels.
 - 7. Miscellaneous identification products.

1.3 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.
- C. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and ANSI C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.145.

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Color for Printed Legend:
 - 1. Power Circuits: Black letters on an orange field.
 - 2. Legend: Indicate system or service and voltage, if applicable.
- C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- D. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, **2 inches (50 mm)** long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- F. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; **2 inches (50 mm)** wide; compounded for outdoor use.

2.2 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than **3 mils (0.08 mm)** thick by **1 to 2 inches (25 to 50 mm)** wide.
- B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- C. Aluminum Wraparound Marker Labels: Cut from **0.014-inch- (0.35-mm-)** thick aluminum sheet, with stamped, embossed, or scribed legend, and fitted with tabs and matching slots for permanently securing around wire or cable jacket or around groups of conductors.
- D. Metal Tags: Brass or aluminum, **2 by 2 by 0.05 inch (50 by 50 by 1.3 mm)**, with stamped legend, punched for use with self-locking nylon tie fastener.
- E. Write-On Tags: Polyester tag, **0.010 inch (0.25 mm)** thick, with corrosion-resistant grommet and polyester or nylon tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.3 UNDERGROUND-LINE WARNING TAPE

- A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.
 1. Not less than **6 inches (150 mm)** wide by **4 mils (0.102 mm)** thick.
 2. Compounded for permanent direct-burial service.
 3. Embedded continuous metallic strip or core.
 4. Printed legend shall indicate type of underground line.

2.4 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
- C. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. **1/4-inch (6.4-mm)** grommets in corners for mounting. Nominal size, **7 by 10 inches (180 by 250 mm)**.
- D. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with **0.0396-inch (1-mm)** galvanized-steel backing; and with colors, legend, and size required for application. **1/4-inch (6.4-mm)** grommets in corners for mounting. Nominal size, **10 by 14 inches (250 by 360 mm)**.
- E. Warning label and sign shall include, but are not limited to, the following legends:
 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR **36 INCHES (915 MM)**."

2.5 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum **1/16 inch (1.6 mm)** thick for signs up to **20 sq. in. (129 sq. cm)** and **1/8 inch (3.2 mm)** thick for larger sizes.
 1. Engraved legend with black letters on white face.
 2. Punched or drilled for mechanical fasteners.
 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.6 EQUIPMENT IDENTIFICATION LABELS

- A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be **3/8 inch (10 mm)**.

- B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be **3/8 inch (10 mm)**. Overlay shall provide a weatherproof and ultraviolet-resistant seal for label.
- C. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be **3/8 inch (10 mm)**.
- D. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be **3/8 inch (10 mm)**.
- E. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be **1 inch (25 mm)**.

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
 - 1. Minimum Width: **3/16 inch (5 mm)**.
 - 2. Tensile Strength: **50 lb (22.6 kg)**, minimum.
 - 3. Temperature Range: **Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C)**.
 - 4. Color: Black, except where used for color-coding.
- B. Paint: Paint materials and application requirements are specified in Division 09 painting Sections.
- C. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Raceways and Duct Banks More Than 600 V Concealed within Buildings: **4-inch- (100-mm-)** wide black stripes on **10-inch (250-mm)** centers over orange background that extends full length of raceway or duct and is **12 inches (300 mm)** wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with **3-inch- (75-mm-)** high black letters on **20-inch (500-mm)** centers. Stop stripes at legends. Apply to the following finished surfaces:
 - 1. Floor surface directly above conduits running beneath and within **12 inches (300 mm)** of a floor that is in contact with earth or is framed above unexcavated space.
 - 2. Wall surfaces directly external to raceways concealed within wall.
 - 3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.
- B. Power-Circuit Conductor Identification: For secondary conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.
- C. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use color-coding conductor tape aluminum wraparound marker labels. Identify each ungrounded conductor according to source and circuit number.

- D. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source and circuit number.
- E. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.
- F. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
- G. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply baked-enamel warning signs. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
 - 1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
 - 2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
- H. Instruction Signs:
 - 1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
 - 2. Emergency Operating Instructions: Install instruction signs with white legend on a red background with minimum **3/8-inch- (10-mm-)** high letters for emergency instructions at equipment used for power transfer.
- I. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
 - 1. Labeling Instructions:
 - a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with **1/2-inch- (13-mm-)** high letters on **1-1/2-inch- (38-mm-)** high label; where 2 lines of text are required, use labels **2 inches (50 mm)** high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.

- c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
2. Equipment to Be Labeled:
- a. Panelboards, electrical cabinets, and enclosures.
 - b. Access doors and panels for concealed electrical items.
 - c. Electrical switchgear and switchboards.
 - d. Transformers.
 - e. Electrical substations.
 - f. Emergency system boxes and enclosures.
 - g. Motor-control centers.
 - h. Disconnect switches.
 - i. Enclosed circuit breakers.
 - j. Motor starters.
 - k. Push-button stations.
 - l. Power transfer equipment.
 - m. Contactors.
 - n. Remote-controlled switches, dimmer modules, and control devices.
 - o. Battery inverter units.
 - p. Battery racks.
 - q. Power-generating units.
 - r. Voice and data cable terminal equipment.
 - s. Master clock and program equipment.
 - t. Intercommunication and call system master and staff stations.
 - u. Television/audio components, racks, and controls.
 - v. Fire-alarm control panel and annunciators.
 - w. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
 - x. Monitoring and control equipment.
 - y. Uninterruptible power supply equipment.
 - z. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.

3.2 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- F. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at **50-foot (15-m)** maximum intervals in straight runs, and at **25-foot (7.6-m)** maximum intervals in congested areas.

- G. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.
1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.
 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 3. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of **6 inches (150 mm)** from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at **6 to 8 inches (150 to 200 mm)** below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds **16 inches (400 mm)** overall.
- J. Painted Identification: Prepare surface and apply paint according to Division 09 painting Sections.

END OF SECTION

SECTION 260572

OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. All sections of Division 01, General Requirements, apply to this section.
- B. Coordinate with Commissioning Work. Comply with the requirements of Division 01 Section "General Commissioning Requirements" and Division 26 Section "Electrical Commissioning."

1.2 SUMMARY

- A. Section includes a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.

1.3 DEFINITIONS

- A. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- B. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- C. SCCR: Short-circuit current rating.
- D. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 SUBMITTALS

- A. Provide submittals in accordance with project requirements.
- B. Product Data: For computer software program to be used for studies.
- C. Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form:
 - 1. Short-circuit study input data, including completed computer program input data sheets.
 - 2. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.
 - a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

- b. Revised single-line diagram, reflecting field investigation results and results of short-circuit study.
- D. Submit a separate copy of the complete short-circuit study and settings to the AHJ for review and approval prior to implementation.
- E. Qualification Data: For Short-Circuit Study Software Developer, Short-Circuit Study Specialist, and Field Adjusting Agency.
- F. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: After adjustable over current devices are properly set in the field per the recommendations of the short-circuit study, tabulate breaker settings and provide them to the Architect for inclusion in the Operations and Maintenance manual.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. The following parts from the Short-Circuit Study Report:
 - 1) One-line diagram.
 - b. Power system data.
 - c. Electronic file containing one-line diagram used for short-circuit study, in native format, so that it can be updated later as necessary without needing to recreate entire one-line diagram from scratch.

1.6 SUBSTITUTIONS

- A. Submit request for substitution of materials as part of product submittal, in accordance with the requirements of Division 01.

1.7 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.
- B. The same computer software from a single manufacturer shall be utilized for all three overcurrent protective device studies covered under sections 260572 "Overcurrent Protective Device Short-Circuit Study", 260573 "Overcurrent Protective Device Coordination Study", and 260574 "Overcurrent Protective Device Arc-Flash Study". Using different software from multiple software developers to complete each study is not acceptable.
- C. Short-Circuit Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 - 1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
- D. Short-Circuit Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the State of Utah. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

- E. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE

- A. Software Developers: Subject to compliance with requirements, available software developers offering software that may be used for the Work include, but are not limited to, the following:
 - 1. SKM Systems Analysis, Inc. (Power Tools for Windows).
- B. Comply with IEEE 399 and IEEE 551.
- C. Analytical features of fault-current-study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

- A. Executive summary.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of the computer printout.
- C. One-line diagram, showing the following:
 - 1. Protective device designations and ampere ratings.
 - 2. Cable size and lengths.
 - 3. Transformer kilovolt ampere (kVA) and voltage ratings.
 - 4. Motor and generator designations and kVA ratings.
 - 5. Switchgear, switchboard, motor-control center, and panelboard designations.
- D. Comments and recommendations for system improvements, where needed.
- E. Protective Device Evaluation:
 - 1. Evaluate equipment and protective devices and compare to short-circuit ratings.
 - 2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
 - 3. For 600V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
 - 4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
 - 5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
- F. Short-Circuit Study Input Data: As described in "Power System Data" Article in the Evaluations.

- G. Short-Circuit Study Output:
1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. Equivalent impedance.
 2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. Calculated asymmetrical fault currents:
 - 1) Based on fault-point X/R ratio.
 - 2) Based on calculated symmetrical value multiplied by 1.6.
 - 3) Based on calculated symmetrical value multiplied by 2.7.
 3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. No AC Decrement (NACD) ratio.
 - e. Equivalent impedance.
 - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
 - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Obtain all data necessary for the conduct of the study.
1. Verify completeness of data supplied on the one-line diagram. Call any discrepancies to the attention of Architect.
 2. For equipment provided that is Work of this Project, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
- B. Gather and tabulate the following input data to support the short-circuit study. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 2. Obtain electrical power utility impedance at the service.
 3. Power sources and ties.
 4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
 5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
 6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.

7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
8. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
9. Motor horsepower and NEMA MG 1 code letter designation.
10. Cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.2 SHORT-CIRCUIT STUDY

- A. Perform study following the general study procedures contained in IEEE 399.
- B. Calculate short-circuit currents according to IEEE 551.
- C. Base study on the device characteristics supplied by device manufacturer.
- D. The extent of the electrical power system to be studied is indicated on Drawings.
- E. Begin short-circuit current analysis at the service, extending down to the system overcurrent protective devices as follows:
 1. To normal system low-voltage load buses where fault current is 10 kA or less.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- G. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.
 1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
- H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each of the following:
 1. Electric utility's supply termination point.
 2. Incoming switchgear.
 3. Unit substation primary and secondary terminals.
 4. Low-voltage switchgear and switchboards.
 5. Motor-control centers.
 6. Control panels.
 7. Standby generators and automatic transfer switches.
 8. Distribution boards and branch circuit panelboards.
 9. Disconnect switches.

3.3 ADJUSTING

- A. Make minor modifications to equipment as required to accomplish compliance with short-circuit study.

3.4 FINAL ANALYSIS AND RECORD REPORT

- A. The project will consist of multiple bid packages and phased construction of the buildings on site. Therefore, it will be necessary to provide a final analysis and record report at the completion of the entire project to document as-built conditions.
- B. The final report shall contain analysis and calculations based on final installed as-built conditions, including but not limited to final utility input data, service and feeder lengths, wire sizes, breaker types, pad mounted transformer impedance, etc.

3.5 DEMONSTRATION

- A. Train Owner's operating and maintenance personnel in the use of study results.

END OF SECTION

SECTION 260573

OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. All sections of Division 01, General Requirements, apply to this section.
- B. Coordinate with Commissioning Work. Comply with the requirements of Division 01 Section "General Commissioning Requirements" and Division 26 Section "Electrical Commissioning."

1.2 SUMMARY

- A. Section includes computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.
 - 1. Study results shall be used to determine coordination of series-rated devices.

1.3 DEFINITIONS

- A. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- B. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- C. SCCR: Short-circuit current rating.
- D. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 SUBMITTALS

- A. Provide submittals in accordance with project requirements.
- B. Product Data: For computer software program to be used for studies.
- C. Submit the following after the approval of system protective devices submittals:
 - 1. Coordination-study input data, including completed computer program input data sheets.
 - 2. Study and equipment evaluation reports.
 - 3. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional engineer.
 - a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal

of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

- D. Submit a separate copy of the complete coordination study and settings to the AHJ for review and approval prior to implementation.
- E. Qualification Data: For Coordination Study Specialist.
- F. Product Certificates: For overcurrent protective device coordination study software, certifying compliance with IEEE 399.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For the overcurrent protective devices to include in emergency, operation, and maintenance manuals. After adjustable over current devices are properly set in the field per the recommendations of the coordination study, tabulate breaker settings and provide them to the Architect for inclusion in the Operations and Maintenance manual.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. The following parts from the Protective Device Coordination Study Report:
 - 1) One-line diagram.
 - 2) Protective device coordination study.
 - 3) Time-current coordination curves.
 - b. Power system data.
 - c. Electronic file containing one-line diagram used for coordination study, in native format, so that it can be updated later as necessary without needing to recreate entire one-line diagram from scratch.

1.6 SUBSTITUTIONS

- A. Submit request for substitution of materials as part of product submittal, in accordance with the requirements of Division 01.

1.7 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.
- B. The same computer software from a single manufacturer shall be utilized for all three overcurrent protective device studies covered under sections 260572 "Overcurrent Protective Device Short-Circuit Study", 260573 "Overcurrent Protective Device Coordination Study", and 260574 "Overcurrent Protective Device Arc-Flash Study". Using different software from multiple software developers to complete each study is not acceptable.
- C. Coordination Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 - 1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

- D. Coordination Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the State of Utah. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Software Developers: Subject to compliance with requirements, provide software by one of the following:
 - 1. SKM Systems Analysis, Inc. (Power Tools for Windows).
- B. Comply with IEEE 242 and IEEE 399.
- C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.
 - 1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

- A. Gather and tabulate the following input data to support coordination study. The list below is a guide. Comply with recommendations in IEEE 241 and IEEE 551 for the amount of detail required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
 - 1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 - 2. Electrical power utility impedance at the service.
 - 3. Power sources and ties.
 - 4. Short-circuit current at each system bus, three phase and line-to-ground.
 - 5. Full-load current of all loads.

6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Maximum demands from service meters.
13. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
14. Motor horsepower and NEMA MG 1 code letter designation.
15. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
16. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
 - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
 - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
 - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
 - d. Generator thermal-damage curve.
 - e. Ratings, types, and settings of utility company's overcurrent protective devices.
 - f. Special overcurrent protective device settings or types stipulated by utility company.
 - g. Time-current-characteristic curves of devices indicated to be coordinated.
 - h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
 - i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
 - j. Panelboards, switchboards, motor-control center ampacity, and SCCR in amperes rms symmetrical.
 - k. Ensure main circuit breaker ground fault protection has been coordinated with 20A/1P branch circuit breakers serving lighting loads at 277/480V systems. There have been several instances where a ground fault on lighting branch circuits will trip the main circuit breaker.

3.3 FIELD ADJUSTING

- A. Adjust relay and protective device settings according to the recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion. After adjustable over current devices are properly set in the field per the recommendations of the coordination study, tabulate breaker settings and provide them to the Architect for inclusion in the Operations and Maintenance manual.
- B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.

- C. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. Perform NETA tests and inspections for all adjustable overcurrent protective devices.

3.4 FINAL ANALYSIS AND RECORD REPORT

- A. The project will consist of multiple bid packages and phased construction of the buildings on site. Therefore, it will be necessary to provide a final analysis and record report at the completion of the entire project to document as-built conditions.
- B. The final report shall contain analysis and calculations based on final installed as-built conditions, including but not limited to final utility input data, service and feeder lengths, wire sizes, breaker types, pad mounted transformer impedance, etc.

3.5 DEMONSTRATION

- A. Engage the Coordination Study Specialist to train Owner's maintenance personnel in the following:
 - 1. Acquaint personnel in the fundamentals of operating the power system in normal and emergency modes.
 - 2. Hand-out and explain the objectives of the coordination study, study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpreting the time-current coordination curves.
 - 3. Adjust, operate, and maintain overcurrent protective device settings.

END OF SECTION

SECTION 260574

OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. All sections of Division 01, General Requirements, apply to this section.
- B. Coordinate with Commissioning Work. Comply with the requirements of Division 01 Section "General Commissioning Requirements".

1.2 SUMMARY

- A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.3 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- D. SCCR: Short-circuit current rating.
- E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 SUBMITTALS

- A. Provide submittals in accordance with project requirements.
- B. Product Data: For computer software program to be used for studies.
- C. Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form:
 - 1. Arc-flash study input data, including completed computer program input data sheets.
 - 2. Arc-flash study report; signed, dated, and sealed by a qualified professional engineer.
 - a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient

study data to ensure that the selection of devices and associated characteristics is satisfactory.

- D. Submit a separate copy of the complete arc flash study and settings to the AHJ for review and approval prior to implementation.
- E. Qualification Data: For Arc-Flash Study Software Developer, Arc-Flash Study Specialist, and Field Adjusting Agency.
- F. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.
- B. In addition to items specified in Section 017823 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.
 - a. The following parts from the Arc-Flash Study Report:
 - 1) One-line diagram.
 - 2) Power system data.
 - b. Electronic file containing one-line diagram used for arc-flash study, in native format, so that it can be updated later as necessary without needing to recreate entire one-line diagram from scratch.

1.6 SUBSTITUTIONS

- A. Submit request for substitution of materials as part of product submittal, in accordance with the requirements of Division 01.

1.7 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.
- B. The same computer software from a single manufacturer shall be utilized for all three overcurrent protective device studies covered under sections 260572 "Overcurrent Protective Device Short-Circuit Study", 260573 "Overcurrent Protective Device Coordination Study", and 260574 "Overcurrent Protective Device Arc-Flash Study". Using different software from multiple software developers to complete each study is not acceptable.
- C. Arc-Flash Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 - 1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

- D. Arc-Flash Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.
- E. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Software Developers: Subject to compliance with requirements, available software developers offering software that may be used for the Work include, but are not limited to, the following:
 - 1. SKM Systems Analysis, Inc. (Power Tools for Windows).
- B. Comply with IEEE 1584 and NFPA 70E.
- C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.2 SHORT-CIRCUIT AND ARC-FLASH STUDY REPORT CONTENT

- A. Executive summary.
- B. Study descriptions, purpose, basis and scope.
- C. One-line diagram, showing the following:
 - 1. Protective device designations and ampere ratings.
 - 2. Cable size and lengths.
 - 3. Transformer kilovolt ampere (kVA) and voltage ratings.
 - 4. Motor and generator designations and kVA ratings.
 - 5. Switchgear, switchboard, motor-control center and panelboard designations.
- D. Study Input Data: As described in "Power System Data" Article.
- E. Short-Circuit Study Output:
 - 1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. No AC Decrement (NACD) ratio.
 - e. Equivalent impedance.

- f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
 - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.
- F. Incident Energy and Flash Protection Boundary Calculations:
 - 1. Arcing fault magnitude.
 - 2. Protective device clearing time.
 - 3. Duration of arc.
 - 4. Arc-flash boundary.
 - 5. Working distance.
 - 6. Incident energy.
 - 7. Hazard risk category.
 - 8. Recommendations for arc-flash energy reduction.
- G. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

2.3 ARC-FLASH WARNING LABELS

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems." Produce a 3.5-inch by 5-inch thermal transfer label of high-adhesion polyester for each work location included in the analysis.
- B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH AND SHOCK HAZARD, Appropriate PPE Required " and shall include the following information taken directly from the arc-flash hazard analysis:
 - 1. Arc-Flash Protection Boundary and Required PPE:
 - a. Flash hazard boundary.
 - b. Hazard risk category.
 - c. Glove class.
 - d. Required PPE.
 - e. Incident energy.
 - 2. Shock Hazard Protection Boundaries:
 - a. Equipment ID.
 - b. Equipment Nominal voltage.
 - c. Approach boundaries: limited, restricted, prohibited.
 - 3. Assessment date.
- C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 SHORT-CIRCUIT STUDY

- A. Perform study as described in Section 260572 “Overcurrent Protective Device Short-Circuit Study.”

3.3 OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

- A. Perform OCPD coordination study as described in Section 260573 “Overcurrent Protective Device Coordination Study.”

3.4 ARC-FLASH HAZARD ANALYSIS

- A. Comply with NFPA 70E and its Annex D for hazard analysis study.
- B. Use the short-circuit study output and the field-verified settings of the overcurrent devices as derived in Sections 260572 “Overcurrent Protective Device Short-Circuit Study” and 260573 “Overcurrent Protective Device Coordination Study.”
- C. Calculate maximum and minimum contributions of fault-current size.
 - 1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.
 - 2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
- D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.
- E. Include medium and low voltage equipment locations.
- F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.
- G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:
 - 1. Fault contribution from induction motors should not be considered beyond three to five cycles.
 - 2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).
- H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:
 - 1. When the circuit breaker is in a separate enclosure.
 - 2. When the line terminals of the circuit breaker are separate from the work location.
- I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.5 POWER SYSTEM DATA

- A. Obtain all data necessary for the conduct of the arc-flash hazard analysis.
1. Verify completeness of data supplied on the one-line diagram on Drawings. Call discrepancies to the attention of Architect.
 2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
 3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers.
- B. Gather and tabulate the following input data to support coordination study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 2. Obtain electrical power utility impedance at the service.
 3. Power sources and ties.
 4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent and phase shift.
 5. For reactors, provide manufacturer and model designation, voltage rating and impedance.
 6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
 7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
 8. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
 9. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
 10. Motor horsepower and NEMA MG 1 code letter designation.
 11. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
 12. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.

3.6 LABELING

- A. Apply one arc-flash label for 600VAC, 480VAC, and applicable 208VAC panelboards and disconnects, and at each of the following locations:
1. Motor-control centers.
 2. Low-voltage switchboards.
 3. Low-voltage switchgears.
 4. Unit Substations.
 5. Medium-voltage switchgears.
 6. Control panels.

3.7 APPLICATION OF WARNING LABELS

- A. Install the arc-fault warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

3.8 FINAL ANALYSIS AND RECORD REPORT

- A. The project will consist of multiple bid packages and phased construction of the buildings on site. Therefore, it will be necessary to provide a final analysis and record report at the completion of the entire project to document as-built conditions.
- B. The final report shall contain analysis and calculations based on final installed as-built conditions, including but not limited to final utility input data, service and feeder lengths, wire sizes, breaker types, pad mounted transformer impedance, etc.

3.9 DEMONSTRATION

- A. Engage the Arc-Flash Study Specialist to train Owner's maintenance personnel in the potential arc-flash hazards associated with working on energized equipment and the significance of the arc-flash warning labels.

END OF SECTION

SECTION 260923

LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following lighting control devices:
 - 1. Indoor occupancy sensors.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
 - 1. Interconnection diagrams showing field-installed wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 TIME SWITCHES

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
1. Area Lighting Research, Inc.; Tyco Electronics.
 2. Grasslin Controls Corporation; a GE Industrial Systems Company.
 3. Intermatic, Inc.
 4. Leviton Mfg. Company Inc.
 5. Lightolier Controls; a Genlyte Company.
 6. Lithonia Lighting; Acuity Lighting Group, Inc.
 7. Paragon Electric Co.; Invensys Climate Controls.
 8. Square D; Schneider Electric.
 9. TORK.
 10. Touch-Plate, Inc.
 11. Watt Stopper (The).

2.2 INDOOR OCCUPANCY SENSORS

- A. 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:
1. Hubbell Lighting.
 2. Leviton Mfg. Company Inc.
 3. Lithonia Lighting; Acuity Lighting Group, Inc.
 4. Novitas, Inc.
 5. RAB Lighting, Inc.
 6. Sensor Switch, Inc.
 7. TORK.
 8. Watt Stopper (The).
- B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.
1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
 3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
 4. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a **1/2-inch (13-mm)** knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.

6. Bypass Switch: Override the on function in case of sensor failure.
 7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lx); keep lighting off when selected lighting level is present.
- C. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

2.3 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

- A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION

- A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 inch (13 mm).

- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
 - 2. Operational Test: Verify operation of each lighting control device, and adjust time delays.
- B. Lighting control devices that fail tests and inspections are defective work.

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two Insert number visits to Project during other-than-normal occupancy hours for this purpose.

3.7 DEMONSTRATION

- A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control system specified in Division 26 Section "Network Lighting Controls."
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 260943

NETWORK LIGHTING CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes networked, PC-based, digital lighting control system with external signal sources, relays and control modules. System shall be able to operate as a stand-alone entity with the options of BAS interface and using a web server device so that programming and viewing of status can be accomplished by any PC connected to the same LAN or via the internet
- B. Related Sections:
 - 1. Division 26 Section "Lighting Control Devices" for time clocks, photoelectric sensors, occupancy sensors, and multipole contactors.
 - 2. Division 26 Section "Central Dimming Controls" or "Modular Dimming Controls" for dimming control components.

1.3 DEFINITIONS

- A. BACnet: A networking communication protocol that complies with ASHRAE 135.
- B. BAS: Building automation system.
- C. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.
- D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling and power-limited circuits.
- E. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.
- F. PC: Personal computer; sometimes plural as "PCs."
- G. RS-485: A serial network protocol, similar to RS-232, complying with TIA-485-A.
- H. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for control modules, power distribution components, manual switches and plates, and conductors and cables.

- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 2. Outline Drawings: Indicate dimensions, weights, arrangement of components, and clearance and access requirements.
 3. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.
 4. Wiring Diagrams: For power, signal, and control wiring. Coordinate nomenclature and presentation with a block diagram.
 - C. Coordination Drawings: Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified in other Sections.
 1. Show interconnecting signal and control wiring and interfacing devices that prove compatibility of inputs and outputs.
 2. For networked controls, list network protocols and provide statements from manufacturers that input and output devices meet interoperability requirements of the network protocol.
 - D. Software and Firmware Operational Documentation:
 1. Software operating and upgrade manuals.
 2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
 3. Device address list.
 4. Printout of software application and graphic screens.
 - E. Field quality-control reports.
 - F. Software licenses and upgrades required by and installed for operation and programming of digital and analog devices.
 - G. Operation and Maintenance Data: For lighting controls to include in emergency, operation, and maintenance manuals.
 - H. Warranty: Sample of special warranty.
- 1.5 QUALITY ASSURANCE
- A. Source Limitations: Obtain lighting control module and power distribution components through one source from a single manufacturer.
 - B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - C. Comply with 47 CFR, Subparts A and B, for Class A digital devices.
 - D. Comply with NFPA 70.
- 1.6 COORDINATION
- A. Coordinate lighting control components to form an integrated interconnection of compatible components.

1. Match components and interconnections for optimum performance of lighting control functions.
2. Coordinate lighting controls with BAS.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of lighting controls that fail in materials or workmanship or from transient voltage surges within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Failure of software input/output to execute switching or dimming commands.
 - b. Failure of modular relays to operate under manual or software commands.
 - c. Damage of electronic components due to transient voltage surges.
 2. Warranty Period: Two years from date of Substantial Completion.
 3. Extended Warranty Period for Electrically Held Relays: 10 years from date of Substantial Completion.

1.8 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Electrically Held Relays: Equal to 10 percent of amount installed, but no fewer than 5 relays.

1.9 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning with Substantial Completion, provide software support for two years.
- B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of the software.
1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Douglas Lighting.
 2. Eaton Controls
 3. Watt Stopper/Legrand.
 4. Hubbell
 5. Lighting Control & Design

2.2 SYSTEM REQUIREMENTS

- A. Performance Requirements: A networked control system consisting of manual switches, an internal timing and control unit, and external sensors or other control signal sources that send a signal to a programmable-system control module that processes the signal according to its programming and routes an open or close command to one or more relays in the power-supply circuits, or routes variable commands to one or more dimmers, for groups of lighting fixtures or

other loads. Any external signal source communicating through one relay panel communicates to any one or all other relay panels. System can be programmed, operated and maintained entirely from any PC by accessing web-based software that is password protected. Control groups consist of one or more relays in one, some or all relay panels.

- B. Expandability: System shall be capable of increasing the number of control functions in the future by 25 percent of current capacity; to include equipment ratings, housing capacities, spare relays, terminals, number of conductors in control cables, and control software.
- C. BAS Interface: Provide hardware and software to enable the BAS to monitor, control, display, and record data for use in processing reports.
 - 1. Hardwired Points:
 - a. Monitoring: On-off status.
 - b. Control: On-off operation.
 - 2. ASHRAE 135 (BACnet) communication interface with the BAS shall enable the BAS operator to remotely control and monitor lighting from a BAS operator workstation. Control features and monitoring points displayed locally at lighting panel shall be available through the BAS.

2.3 CONTROL MODULE

- A. Control Module Description: Comply with UL 508 (CAN/CSA C22.2, No. 14); microprocessor-based, networked, control unit; mounted in preassembled, modular relay panel. Low-voltage-controlled, latching-type, single-pole lighting circuit relays shall be prime output circuit devices. Where indicated, a limited number of digital or analog, low-voltage control-circuit outputs shall be supported by control unit and circuit boards associated with relays. Control units shall be capable of receiving inputs from sensors and other sources. Line-voltage components and wiring shall be separated from low-voltage components and wiring by barriers. Control module shall be locally programmable with integral keypad, or by a laptop or other PC. Multiple panels in a network shall all be programmable from one location.

2.4 POWER DISTRIBUTION COMPONENTS

- A. Modular Relay Panel: Comply with UL 508 (CAN/CSA C22.2, No. 14) and UL 916 (CSA C22.2, No. 205); factory assembled with modular single-pole relays, power supplies, and accessory components required for specified performance.
 - 1. Cabinet: Steel with hinged, locking door.
 - a. Barriers separate low-voltage and line-voltage components.
 - b. Directory: Mounted on back of door. Identifies each relay as to load groups controlled and each programmed pilot device if any.
 - c. Control Power Supply: Transformer and full-wave rectifier with filtered dc output.
 - 2. Single-Pole Relays: Mechanically held unless otherwise indicated; split-coil, momentary-pulsed type.
 - a. Low-Voltage Leads: Plug connector to the connector strip in cabinet and pilot light power where indicated.
 - b. Rated Capacity (Mounted in Relay Panel): 20 A, 125-V ac for tungsten filaments; 20 A, 277-V ac for ballasts.
 - c. Endurance: 50,000 cycles at rated capacity.
 - d. Manually switching capability.
 - e. Mounting: Provision for easy removal and installation in relay cabinet.
- B. Line-Voltage Surge Suppression: Factory installed as an integral part of 120- and 277-V ac, solid-state control panels.

2.5 MANUAL ANALOG SWITCHES AND PLATES

- A. Push-Button Switches: Modular, momentary-contact, low-voltage type.
 - 1. Match color specified in Division 26 Section "Wiring Devices."
 - 2. Integral green LED pilot light to indicate when circuit is on.
 - 3. Internal white LED locator light to illuminate when circuit is off.
- B. Manual, Maintained Contact, Full- or Low-Voltage Switch: Comply with Division 26 Section "Wiring Devices."
- C. Wall Plates: Single and multigang plates as specified in Division 26 Section "Wiring Devices."
- D. Legend: Engraved or permanently silk-screened on wall plate where indicated. Use designations indicated on Drawings.

2.6 FIELD-MOUNTED DIGITAL CONTROLS AND PLATES

- A. Connection Type: RS-485 protocol, category 5e UTP cable, using RJ45 connectors. Power shall be from the control unit.
- B. Pushbutton Switches: Modular, solid-state, programmable, digital, momentary contact, designed to connect to a microprocessor based control unit as a manual control source.
 - 1. Mounting: Standard single-gang recessed switchbox, using device plates specified in Division 26 Section "Wiring Devices."
 - 2. Multi-Gang Mounting: One to six pushbuttons per gang.

2.7 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG, complying with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cables: Stranded copper, complying with UL 83, multiconductor cable with copper conductors not smaller than No. 18 AWG, complying with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cables: Stranded copper, complying with UL 83, multiconductor cable with copper conductors not smaller than No. 14 AWG, complying with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- D. Structured Network Digital and Multiplexed Signal Cables: UTP cable with copper conductors, complying with TIA/EIA-568-B.2, Category 6 for horizontal copper cable and with Division 27 Section "Communications Horizontal Cabling."
- E. RS-485 Cables:
 - 1. Plenum-Rated Cable: NFPA 70, Type CMP.
 - a. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
 - b. Fluorinated ethylene propylene insulation.
 - c. Unshielded.
 - d. Fluorinated ethylene propylene jacket.
 - e. Flame Resistance: NFPA 262, Flame Test.

PART 3 - EXECUTION

3.1 WIRING INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Install wiring in raceways. Minimum conduit size shall be **1/2 inch (13 mm)**.
 - 1. For power wiring comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables"
 - 2. For digital data transmission and low-voltage (operating at less than 50 V) remote control and signaling cables, comply with Division 26 Section "Control-Voltage Electrical Power Cables"
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.
- D. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.
- E. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- F. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in terminal cabinets, equipment enclosures, and in junction, pull, and outlet boxes.
- G. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, program and adjust components, assemblies, and equipment installations, including connections.
 - 1. Include initial set up of computer graphics, including a building model with all unique lighting zones shown.
- B. Tests and Inspections:
 - 1. Test for circuit continuity.
 - 2. Verify that the control module features are operational.
 - 3. Check operation of local override controls.
 - 4. Test system diagnostics by simulating improper operation of several components selected by Architect.
- C. Lighting controls will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.3 SOFTWARE INSTALLATION

- A. Install and program software with initial settings of adjustable values. Make backup copies of software and user-supplied values. Provide current licenses for software.

3.4 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting controls and software training for PC-based control systems. See Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 262413

SWITCHBOARDS

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. Service and distribution switchboards rated 600 V and less.
 - 2. Transient voltage suppression devices.
 - 3. Disconnecting and overcurrent protective devices.
 - 4. Instrumentation.
 - 5. Control power.
 - 6. Accessory components and features.
 - 7. Identification.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Switchboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.4 SUBMITTALS

- A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
- B. Shop Drawings: For each switchboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
 - 5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
 - 6. Detail utility company's metering provisions with indication of approval by utility company.

7. Include evidence of NRTL listing for series rating of installed devices.
 8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 9. Include schematic and wiring diagrams for power, signal, and control wiring.
- C. Seismic Qualification Certificates: Submit certification that switchboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Field Quality-Control Reports:
1. Test procedures used.
 2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- E. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Routine maintenance requirements for switchboards and all installed components.
 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 3. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.
- B. Testing Agency Qualifications: Member company of NETA or an NRTL.
1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- C. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- E. 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.

- F. Comply with NEMA PB 2.
- G. Comply with NFPA 70.
- H. Comply with UL 891.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.
- B. Handle and prepare switchboards for installation according to NECA 400.

1.7 PROJECT CONDITIONS

- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.
- B. Environmental Limitations:
 - 1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
 - b. Altitude: Not exceeding 6600 feet (2000 m).
- C. Service Conditions: NEMA PB 2, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet (2000 m).
- D. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Architect no fewer than seven days in advance of proposed interruption of electric service.
 - 2. Indicate method of providing temporary electric service.
 - 3. Do not proceed with interruption of electric service without Architect's and Hill AFB written permission.
 - 4. Comply with NFPA 70E.

1.8 COORDINATION

- A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces.

Maintain required workspace clearances and required clearances for equipment access doors and panels.

- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

- 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Company Pow-R-Line C series.
 - 2. GE Consumer & Industrial - Electrical Distribution. Spectra Class 2 Series.
 - 3. Square D; Schneider Electric.
 - 4. Siemens SB2 series.
- B. Front-Connected, Front-Accessible Switchboards:
 - 1. Main Devices: Fixed, individually mounted.
 - 2. Branch Devices: Panel mounted.
 - 3. Sections front and rear aligned.
- C. Seismic Requirements: Fabricate and test switchboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- D. Indoor Enclosures: Steel, NEMA 250, Type 1.
- E. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
- F. Outdoor Enclosures: Type 3R.
 - 1. Finish: Factory-applied finish in manufacturer's standard color; undersurfaces treated with corrosion-resistant undercoating.
 - 2. Enclosure: Flat roof; bolt-on rear covers for each section, with provisions for padlocking.
- G. Barriers: Between adjacent switchboard sections.
- H. Insulation and isolation for main and vertical buses of feeder sections.
- I. Utility Metering Compartment: Fabricated, barrier compartment and section complying with utility company's requirements; hinged sealed door; buses provisioned for mounting utility

company's current transformers and potential transformers or potential taps as required by utility company. If separate vertical section is required for utility metering, match and align with basic switchboard. Provide service entrance label and necessary applicable service entrance features.

- J. Customer Metering Compartment: A separate customer metering compartment and section with front hinged door, for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks.
- K. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
- L. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.
- M. Buses and Connections: Three phase, four wire unless otherwise indicated.
 - 1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity.
 - 2. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
 - 3. Ground Bus: Minimum-size required by UL 891, hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors.
 - 4. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
 - 5. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
 - 6. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.
- N. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.
- O. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105 deg C.
- P. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components including instruments and instrument transformers.

2.2 TRANSIENT VOLTAGE SUPPRESSION DEVICES

- A. 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:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
 - 5. Original Equipment Manufacturer (OEM): Listed for use in provided switchboard.
- B. Surge Protection Device Description: IEEE C62.41-compliant, externally mounted, bolt-on, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating

matching or exceeding the switchboard short-circuit rating, and with the following features and accessories:

1. Fuses, rated at 200-kA interrupting capacity.
2. Fabrication using bolted compression lugs for internal wiring.
3. Integral disconnect switch.
4. Redundant suppression circuits.
5. Redundant replaceable modules.
6. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
7. LED indicator lights for power and protection status.
8. Audible alarm, with silencing switch, to indicate when protection has failed.
9. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
10. Four-digit, transient-event counter set to totalize transient surges.

C. Peak Single-Impulse Surge Current Rating: 160 kA per mode/320 kA per phase.

D. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.

E. Protection modes and UL 1449 SVR for grounded wye circuits with 480Y/277-V, three-phase, four-wire circuits shall be as follows:

1. Line to Neutral: 800 V for 480Y/277.
2. Line to Ground: 800 V for 480Y/277.
3. Neutral to Ground: 800 V for 480Y/277.

F. Protection modes and UL 1449 SVR for 240/120-V, three-phase, four-wire circuits with high leg shall be as follows:

1. Line to Neutral: 400 V, 800 V from high leg.
2. Line to Ground: 400 V.
3. Neutral to Ground: 400 V.

G. Protection modes and UL 1449 SVR for 240-, 480-, or 600-V, three-phase, three-wire, delta circuits shall be as follows:

1. Line to Line: 2000 V for 480 V.
2. Line to Ground: 1500 V for 480 V.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

- a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I²t response.
4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
 6. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
 7. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
 8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
 - f. Communication Capability: Universal-mounted communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
 - g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
 - h. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - i. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
 - j. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

2.4 INSTRUMENTATION

- A. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
 1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
 - a. Phase Currents, Each Phase: Plus or minus 1 percent.
 - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
 - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
 - d. Megawatts: Plus or minus 2 percent.
 - e. Megavars: Plus or minus 2 percent.
 - f. Power Factor: Plus or minus 2 percent.
 - g. Frequency: Plus or minus 0.5 percent.

- h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.
 - i. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from five to 60 minutes.
 - j. Contact devices to operate remote impulse-totalizing demand meter.
2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

2.5 CONTROL POWER

- A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.
- B. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.
- C. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.6 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.

2.7 IDENTIFICATION

- A. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store switchboards according to NECA 400.
- B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.
- C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install switchboards and accessories according to NECA 400.
- B. Equipment Mounting: Install switchboards on concrete base, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete Miscellaneous Cast-in-Place Concrete."
 - 1. 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 concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to switchboards.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
- D. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
- F. Install filler plates in unused spaces of panel-mounted sections.
- G. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.
 - 1. Set field-adjustable switches and circuit-breaker trip ranges.
- H. Comply with NECA 1.

3.3 CONNECTIONS

3.4 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Switchboard will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as indicated.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories.

END OF SECTION

SECTION 262416

PANELBOARDS

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. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.
 - 3. Load centers.
 - 4. Electronic-grade panelboards.

1.3 DEFINITIONS

- A. SVR: Suppressed voltage rating.
- B. TVSS: Transient voltage surge suppressor.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.5 SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.

5. Include evidence of NRTL listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.
8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device.

C. Qualification Data: For qualified testing agency.

D. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

F. Panelboard Schedules: For installation in panelboards.

G. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handle and prepare panelboards for installation according to NECA 407.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding **minus 22 deg F (minus 30 deg C)** to **plus 104 deg F (plus 40 deg C)**.
 - b. Altitude: Not exceeding **6600 feet (2000 m)**.

- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding **6600 feet (2000 m)**.

1.9 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Five years from date of Substantial Completion.

1.11 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Keys: Two Insert number spares for each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Enclosures: Surface-mounted cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 - 4. Finishes:
 - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Same finish as panels and trim.
 - 5. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.
- C. Incoming Mains Location: Top and bottom.
- D. Phase, Neutral, and Ground Buses:
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Main and Neutral Lugs: Mechanical type.
 - 3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
- F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- G. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Square D; Schneider Electric.

- 4. Siemens.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 - 1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.
- D. Mains: Circuit breaker
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or lugs only.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
3. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
4. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
5. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
 - f. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - g. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
 - h. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
 - i. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
 - j. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position.
 - k. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.5 PANELBOARD SUPPRESSORS

- A. 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:
 1. Current Technology; a subsidiary of Danahar Corporation.
 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 4. Liebert Corporation.
 5. Siemens Energy & Automation, Inc.
 6. Square D; a brand of Schneider Electric.
 7. Original Equipment Manufacturer (OEM): Listed for use in provided switchboard.
- B. Surge Protection Device: IEEE C62.41-compliant, externally mounted, solid-state, parallel-connected, non-modular type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the panelboard short-circuit rating, and with the following features and accessories:
 1. Accessories:
 - a. LED indicator lights for power and protection status.
 - b. Audible alarm, with silencing switch, to indicate when protection has failed.
 - c. One set of dry contacts rated at 5 A and 250-V ac, for remote monitoring of protection status.

C. Surge Protection Device: IEEE C62.41-compliant, externally mounted, bolt-on, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the panelboard short-circuit rating, and with the following features and accessories:

1. Accessories:

- a. Fuses rated at 200-kA interrupting capacity.
- b. Fabrication using bolted compression lugs for internal wiring.
- c. Integral disconnect switch.
- d. Redundant suppression circuits.
- e. Redundant replaceable modules.
- f. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
- g. LED indicator lights for power and protection status.
- h. Audible alarm, with silencing switch, to indicate when protection has failed.
- i. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
- j. Four-digit, transient-event counter set to totalize transient surges.

2. Peak Single-Impulse Surge Current Rating: 120 kA per mode/240 kA per phase.

3. Minimum single-impulse current ratings, using 8-by-20-mic.sec. waveform described in IEEE C62.41.2.

- a. Line to Neutral: 70,000 A.
- b. Line to Ground: 70,000 A.
- c. Neutral to Ground: 50,000 A.

4. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.

5. Protection modes and UL 1449 SVR for grounded wye circuits with 208Y/120-V, three-phase, four-wire circuits shall be as follows:

- a. Line to Neutral: 400 V for 208Y/120.
- b. Line to Ground: 400 V for 208Y/120.
- c. Neutral to Ground: 400 V for 208Y/120.

2.6 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NECA 407.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install panelboards and accessories according to NECA 407.
- B. Equipment Mounting: Install panelboards on concrete bases, **4-inch (100-mm)** nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch (450-mm)** centers around full perimeter of base.
 - 2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to panelboards.
 - 5. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- D. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- E. Mount top of trim **90 inches (2286 mm)** above finished floor unless otherwise indicated.
- F. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- G. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- H. Install filler plates in unused spaces.
- I. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- J. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- D. Panelboards will be considered defective if they do not pass tests and inspections.

- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as indicated

END OF SECTION

SECTION 262726

WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Twist-locking receptacles.
 - 3. Snap switches.
 - 4. Cord and plug sets.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 - 1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
 - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 - 3. Leviton Mfg. Company Inc. (Leviton).
 - 4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 5351 (single), 5352 (duplex).
 - b. Hubbell; HBL5351 (single), CR5352 (duplex).
 - c. Leviton; 5891 (single), 5352 (duplex).
 - d. Pass & Seymour; 5381 (single), 5352 (duplex).

2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; GF20.
 - b. Pass & Seymour; 2084.

2.4 TWIST-LOCKING RECEPTACLES

- A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.
 - 1. Products: Subject to compliance with requirements, provide one of the following—with NEMA configuration as indicated on the drawings:
 - a. Cooper;
 - b. Hubbell; .
 - c. Leviton; .
 - d. Pass & Seymour.

2.5 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
 - 1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
 - 2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.6 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
 - b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
 - c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
 - d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).
- C. Pilot Light Switches, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221PL for 120 V and 277 V.
 - b. Hubbell; HPL1221PL for 120 V and 277 V.
 - c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
 - d. Pass & Seymour; PS20AC1-PLR for 120 V.
 - 2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

2.7 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

2.8 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailling existing conductors is permitted provided the outlet box is large enough.
- D. Device Installation:
1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.

3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
2. Test Instruments: Use instruments that comply with UL 1436.
3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.

4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION

SECTION 262726.1

WIRING DEVICE SCHEDULE

Wiring Device Schedule		
<p>Note to Bidders: Comply with Section 262726 of the specifications. The catalog numbers listed below have been carefully prepared with the assistance of the manufacturer's representatives with the objective of assisting the bidders in determining the quality and ratings of the wiring device specified; however, the catalog numbers may not be complete or accurate. In addition, the color of the wiring device is not intended to be determined by the catalog numbers listed below, but shall be selected by the Architect as indicated in the specification. Each manufacturer prior to bidding shall compare catalog numbers shown with the description and shall notify the Architect/Engineer of any discrepancies.</p>		
NEMA	DESCRIPTION	CATALOG NUMBERS
NEMA 5-20R	20A, 125V 2 pole 3 wire duplex grounding receptacles. Nylon or Lexan Faces. Back and side wired. Comply with FS W-C-596 and UL 498.	Bryant 5352 Hubbell CR5352 Leviton 5352 P&S 5352
NEMA 5-20R GFCI	20A, 125V 2 pole 3 wire duplex feed thru GFCI receptacles UL-listed and marked "WR" weather resistant; with indicator light. Nylon or Lexan decorator faces. Back and side wired. Internal components shall comply with FS W-C-596 where applicable. Comply with UL 498 and UL 493.	Bryant GFR53FT Hubbell GF5352 Leviton 6898 P&S 2091 S
NEMA 5-20R Isolated Ground	20A, 125V 2 pole 3 wire isolated ground duplex grounding receptacles. Nylon or Lexan faces. Back and side wired. Comply with FS W-C-596 and UL 498.	Bryant 5362IG Hubbell CR5352IG Leviton 5362 - IG P&S IG6300
NEMA 5-20R Hospital Grade	20A, 125V 2 pole 3 wire duplex grounding receptacles. Nylon or Lexan Faces. Back and side wired. Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498 Supplement SD	Cooper 8300 Hubbell HBL8300H Leviton 8300
NEMA 5-20R Hospital Grade GFCI	20A, 125V 2 pole 3 wire duplex grounding receptacles. Nylon or Lexan Faces. Back and side wired. Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498 Supplement SD	Cooper HGF20 Hubbell HGF8300 Leviton 6898-G P&S 2091-SHG
NEMA 5-20R Tamper Resistant	20A, 125V 2 pole 3 wire duplex grounding receptacles. Nylon or Lexan Faces. Back and side wired. Comply with FS W-C-596 and UL 498; Labeled to comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section	Cooper TR8300 Hubbell HBL8300SG Leviton 8300-SGG P&S 63H
NEMA 5-20R Waterproof (Weatherproof in use) GFCI	20A, 125V 2 pole 3 wire duplex feed thru GFCI receptacles with UL-listed and marked "WR" weather resistant; indicator light; Comply with FS W-C-596 and UL 498. Fully gasketed, metal weatherproof while in use enclosure. Plastic covers are not acceptable.	Leviton M5979-0GY cover With the following devices: Hubbell GFTR20 Bryant GFTR20
NEMA 5-20R	20A, 125V 2 pole 3 wire duplex feed thru	Appleton U-Line/Contender

Weatherproof GFCI	GFCI receptacles with UL-listed and marked "WR" weather resistant; Nylon or Lexan Faces. Back and side wired. Comply with FS W-C-596 and UL 498. Cast aluminum and UL listed for wet locations.	ENRC 21201 With the following devices: Hubbell GFTR20 Bryant GFTR20
NEMA 5-20R Explosion-Proof	20A, 125V 2 pole 3 wire grounding, dead-front receptacle. Class 1 Division 1 and 2 rated for hazardous locations.	Hubbell HBL5206WO
20A Single Pole	20A single pole 125V-277V standard toggle switch labeled as complying UL standard 20 and with Federal Specification W-S-896. Provide Nylon or Lexan face, back and side wired. Rated 1 HP 120V.	Hubbell CS1221 Leviton 1221 P & S 521 Bryant 4901
20A Three-way	20A three-way 125V-277V standard toggle switch labeled as complying UL standard 20 and with Federal Specification W-S-896. Provide Nylon or Lexan face, back and side wired. Rated 1 HP 120V.	Hubbell CS1223 Leviton 1223 P & S 523 Bryant 4903
20A Four-way	20A four-way 125V-277V standard toggle switch labeled as complying UL standard 20 and with Federal Specification W-S-896. Provide Nylon or Lexan face, back and side wired. Rated 1 HP 120V.	Hubbell CS1224 Leviton 1224 P & S 524 Bryant 4904
20A Double Pole	20A double pole 125V-277V standard toggle switch labeled as complying UL standard 20 and with Federal Specification W-S-896. Provide Nylon or Lexan face, back and side wired. Rated 2 HP 240V. Double pole.	Hubbell CS1222 Leviton 1222 P & S 522 Bryant 4902
20A Single Pole Explosion Proof	20A single pole 125V-277V; Class 1 Division 1 and 2 rated for hazardous locations. Rated 1 HP 120V.	Appleton EDS-175-F1
20A Three-way Explosion Proof	20A 3-way 125V-277V; Class 1 Division 1 and 2 rated for hazardous locations. Rated 1 HP 120V.	Appleton EDS-175-F3
FB1	Flush single service floor box suitable for the wiring method used. NEMA 5-20R duplex receptacle with brass plate and hinged receptacle covers. Housing material shall be stamped steel.	Hubbell B2421/S3825/SB3083 Walker (provide appropriate cover for floor surface in each specific area)
FB2	Flush dual service floor box suitable for the wiring method used, 2-gang, 2.75" deep. NEMA 5-20R duplex receptacle with brass plate and hinged receptacle covers; blank brass lids for voice/data outlets. Housing material shall be stamped steel.	Hubbell B2422/S3825/S2625 Walker (provide appropriate cover for floor surface in each specific area)
FB3	Flush three service floor box suitable for the wiring method used, 3-gang, 2.75" deep. NEMA 5-20R duplex receptacle	Hubbell B2423/S3825/(2)S2425 Walker

	with brass plate and hinged receptacle covers; blank brass lids for AV and voice/data outlets. Housing material shall be stamped steel.	(provide appropriate cover for floor surface in each specific area)
FB4	Flush 4-service shallow box. 10" x 10" x 2.5" 11 gauge flush hinged steel cover. Provide lift-off full access door and hinged trap-door for cables to exit. Provide two duplex outlets and two single-gang blank outlets for Owner's voice/data jacks. Provide leveling feet for in concrete installation.	Hubbell CFB401 (provide appropriate cover for floor surface in each specific area) Walker
FB5	Flush 2-service box suitable for installation in concrete; damp rated. Traffic-rated lid and box tested to 5,500 lbs minimum; hinged stainless steel cover plate. Provide duplex power outlet and single-gang blank outlets for Owner's voice/data jacks. Obtain sample of Owner's voice/data jacks for insert coordination.	CUBS WP2-custom Cole 351 (provide appropriate cover for floor surface in each specific area)
FB8	Flush 4-service deep box. 10" x 12" x 6" deep; 0.125" metal top; exposed lid is 6.5" x 8" no flange for hard floors, flange for carpeted floors; metal trim as selected by Architect; Provide lift-off full access door and hinged trap-door for cables to exit. Provide two duplex outlets and two single-gang blank outlets for Owner's voice/data jacks. Provide leveling feet for in concrete installation.	FSR FL-500P (provide appropriate cover for floor surface in each specific area) www.fsrinc.com
FB12	Flush 4-service floorbox; heavy-duty traffic rated ASHTO H20 loads; 13" x 15" x 7" deep; constructed with 7/8" thick heat-treated aluminum; Provide duplex power outlet, single-gang blank outlets for Owner's voice/data jacks, and audio/video outlets as indicated on AV drawings and details.	FSR FLH20-xx (provide appropriate cover for floor surface in each specific area)
TT1	Table-Top/Pedestal style 8-gang (4-gangs back-to-back) outlet with two duplex receptacle outlets and two 1-gang voice/data outlets per side. Spot-welded construction with 16-gauge cold rolled steel; pedestal base; power-coat finish in color selected by Architect	Spider Manufacturing/Hubbell PSCS-4BB REV1
PT1	Fire rated poke-thru: four simplex power receptacles with spring loaded lift cover flaps space for four RJ-45 voice/data jacks. Thru floor fitting shall fit in 3" or 4" diameter hole and shall be rated for floor penetrated. Provide carpet flange.	Hubbell S1PT4X4XX Legrand RC9 series
PT2	Fire rated poke-thru: 8-wire furniture connection and 2 cable openings for 6PR cables. Thru floor fitting shall fit in 3"	Hubbell PT73FFSDX Walker RC700-6A

	diameter hole and shall be rated for floor penetrated. Provide carpet flange.	
PT3	Fire rated poke-thru: 3/4" cabling opening and 2 cabling openings for 6PR cables. Thru floor fitting shall fit in 3" diameter hole and shall be rated for floor penetrated. Provide carpet flange.	Hubbell PT73FFSDX Walker RC700-6-4
PP	Power Pole: 12' 6" all with two compartments, power and communication, unwired with blank openings. Verify color with architect.	Hubbell HSP12ABI Wiremold 30TC-412V
CR	Cable Reel: Industrial duty, spring-retractable cable reel in NEMA 4 rated cast aluminum housing; water and dust resistant; #10/4 conductors in 20' min. cord length; include ball stop, mesh wire grip and two duplex NEMA 5-20R receptacles.	Woodhead 92444/3000-10/ 36553/9521

END OF SECTION

SECTION 262813

FUSES

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. Cartridge fuses rated 600 V and less for use in switches.

1.3 SUBMITTALS

- A. Product Data: Include the following for each fuse type indicated:
 - 1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 - 2. Let-through current curves for fuses with current-limiting characteristics.
 - 3. Time-current curves, coordination charts and tables, and related data.
 - 4. Fuse size for elevator feeders and elevator disconnect switches.
- B. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - 1. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - 2. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
- C. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - a. Let-through current curves for fuses with current-limiting characteristics.
 - b. Time-current curves, coordination charts and tables, and related data.
 - c. Ambient temperature adjustment information.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses from a single manufacturer.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NEMA FU 1.
- D. Comply with NFPA 70.

1.5 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Provide one set of each fuse type and size.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Bussman, Inc.
 - 2. Eagle Electric Mfg. Co., Inc.; Cooper Industries, Inc.
 - 3. Ferraz Shawmut, Inc.
 - 4. Tracor, Inc.; Littelfuse, Inc. Subsidiary.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Motor Branch Circuits: Class RK5, time delay.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

- A. Install labels indicating fuse replacement information on inside door of each fused switch.

END OF SECTION

SECTION 262816

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Enclosures.

1.3 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.
- B. HD: Heavy duty.
- C. RMS: Root mean square.
- D. SPDT: Single pole, double throw.

1.4 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current rating.
 - 4. UL listing for series rating of installed devices.
 - 5. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- B. Field quality-control test reports including the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

- C. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
 - 1. Ambient Temperature: Not less than **minus 22 deg F (minus 30 deg C)** and not exceeding **104 deg F (40 deg C)**.
 - 2. Altitude: Not exceeding **6600 feet (2010 m)**.

1.7 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FUSIBLE AND NONFUSIBLE SWITCHES

- A. Manufacturers:
 - 1. Eaton Corporation; Cutler-Hammer Products.
 - 2. General Electric Co.; Electrical Distribution & Control Division.

3. Siemens Energy & Automation, Inc.
 4. Square D/Group Schneider.
- B. Fusible Switch, 600 A and Smaller: NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Nonfusible Switch, 600 A and Smaller: NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- D. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
 3. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

2.3 ENCLOSURES

- A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
1. Outdoor Locations: NEMA 250, Type 3R.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONCRETE BASES

- A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.
- B. Concrete base is specified in Division 26 Section "Hangers and Supports for Electrical Systems," and concrete materials and installation requirements are specified in Division 03.

3.3 INSTALLATION

- A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
- B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.

- C. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.4 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."
- B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Prepare for acceptance testing as follows:
 - 1. Inspect mechanical and electrical connections.
 - 2. Verify switch and relay type and labeling verification.
 - 3. Verify rating of installed fuses.
 - 4. Inspect proper installation of type, size, quantity, and arrangement of mounting or anchorage devices complying with manufacturer's certification.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.6 CLEANING

- A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.
- B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION

SECTION 262913

ENCLOSED CONTROLLERS

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 the following enclosed controllers rated 600 V and less:
 - 1. Full-voltage manual.
 - 2. Full-voltage magnetic.
 - 3. Reduced-voltage solid state.
 - 4. Multispeed.
- B. Related Section:
 - 1. Division 23 Section "Variable-Frequency Motor Controllers" for general-purpose, ac, adjustable-frequency, pulse-width-modulated controllers for use on variable torque loads in ranges up to 200 hp.

1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. N.C.: Normally closed.
- E. N.O.: Normally open.
- F. OCPD: Overcurrent protective device.
- G. SCR: Silicon-controlled rectifier.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed controllers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 SUBMITTALS

- A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.

- B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
 - 1. Show tabulations of the following:
 - a. Each installed unit's type and details.
 - b. Factory-installed devices.
 - c. Nameplate legends.
 - d. Short-circuit current rating of integrated unit.
 - e. Listed and labeled for integrated short-circuit current (withstand) rating of OCPDs in combination controllers by an NRTL acceptable to authorities having jurisdiction.
 - f. Features, characteristics, ratings, and factory settings of individual OCPDs in combination controllers.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Seismic Qualification Certificates: For enclosed controllers, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Routine maintenance requirements for enclosed controllers and installed components.
 - 2. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
 - 3. Manufacturer's written instructions for setting field-adjustable overload relays.
 - 4. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage solid-state controllers.
- F. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

- B. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install temporary electric heating, with at least 250 W per controller.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than **minus 22 deg F (minus 30 deg C)** and not exceeding **104 deg F (40 deg C)**.
 - 2. Altitude: Not exceeding **6600 feet (2010 m)**.
- B. Comply with NFPA 70E.

1.9 COORDINATION

- A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 FULL-VOLTAGE CONTROLLERS

- A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Siemens Energy & Automation, Inc.
 - d. Square D; a brand of Schneider Electric.
 - 2. Configuration: Nonreversing.
 - 3. Flush or surface mounting.
 - 4. Red pilot light.
- C. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Siemens Energy & Automation, Inc.
 - d. Square D; a brand of Schneider Electric.
 - 2. Configuration: Nonreversing.

3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.
 4. Surface mounting.
 5. Red pilot light.
- D. Magnetic Controllers: Full voltage, across the line, electrically held.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Siemens Energy & Automation, Inc.
 - d. Square D; a brand of Schneider Electric.
 2. Configuration: Nonreversing.
 3. Contactor Coils: Pressure-encapsulated type.
 - a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
 4. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
 5. Control Circuits: 24 or 120-V ac, as required by the control circuit; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
 - a. CPT Spare Capacity: 100 VA.
 6. Solid-State Overload Relay:
 - a. Switch or dial selectable for motor running overload protection.
 - b. Sensors in each phase.
 - c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
 - d. Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
 - e. Analog communication module.
 7. N.C./N.O., isolated overload alarm contact.
 8. External overload reset push button.
- E. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Siemens Energy & Automation, Inc.
 - d. Square D; a brand of Schneider Electric.
 2. Fusible Disconnecting Means:
 - a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate indicated fuses.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 - c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
 3. Nonfusible Disconnecting Means:
 - a. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 - c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
 4. MCP Disconnecting Means:

- a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 - c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.
 - d. N.C./N.O. alarm contact that operates only when MCP has tripped.
 - e. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.
5. MCCB Disconnecting Means:
- a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
 - b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - c. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 - d. Auxiliary contacts "a" and "b" arranged to activate with MCCB handle.
 - e. N.C./N.O. alarm contact that operates only when MCCB has tripped.

2.2 MULTISPEED MAGNETIC CONTROLLERS

- A. General Requirements for Multispeed Magnetic Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Multispeed Magnetic Controllers: Two speed, full voltage, across the line, electrically held.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Siemens Energy & Automation, Inc.
 - d. Square D; a brand of Schneider Electric.
 - 2. Configuration: Nonreversing; consequent pole or two winding types as required by the motor being controlled.
 - 3. Contactor Coils: Pressure-encapsulated type.
 - a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
 - 4. Power Contacts: Totally enclosed, double break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
 - 5. Control Circuits: 24 or 120-V ac, as required by the control circuit; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
 - a. CPT Spare Capacity: 100 VA.
 - 6. Compelling relays shall ensure that motor will start only at low speed.
 - 7. Accelerating timer relays shall ensure properly timed acceleration through speeds lower than that selected.
 - 8. Decelerating timer relays shall ensure automatically timed deceleration through each speed.
 - 9. Antiplugging timer relays shall ensure a time delay when transferring from FORWARD to REVERSE and back.
 - 10. Solid-State Overload Relay:
 - a. Switch or dial selectable for motor running overload protection.
 - b. Sensors in each phase.

- c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
 - d. Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
- 11. N.C./N.O., isolated overload alarm contact.
 - 12. External overload reset push button.

2.3 ENCLOSURES

- A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.
 - 1. Dry and Clean Indoor Locations: Type 1.
 - 2. Outdoor Locations: Type 3R.
 - 3. Kitchen and Wash-Down Areas: Type 4X, stainless steel.
 - 4. Other Wet or Damp Indoor Locations: Type 4.
 - 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

2.4 ACCESSORIES

- A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
 - 1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, oiltight type.
 - a. Push Buttons: Covered, lockable types; maintained or momentary as indicated.
 - b. Pilot Lights: LED types; colors as indicated; push to test.
 - c. Selector Switches: Rotary type.
- B. N.C./N.O. auxiliary contact(s).
- C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.
- D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.
- E. Cover gaskets for Type 1 enclosures.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."

- B. Floor-Mounted Controllers: Install enclosed controllers on 4-inch (100-mm) nominal-thickness concrete base. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."
 - 1. 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 concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Seismic Bracing: Comply with requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses in each fusible-switch enclosed controller.
- F. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26 Section "Fuses."
- G. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
- H. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- I. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved nameplate.
 - 3. Label each enclosure-mounted control and pilot device.

3.4 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers and remote devices and facility's central control system. Comply with requirements in Division 26 Section "Control-Voltage Electrical Power Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic-control selection devices where applicable.
 - 1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
 - 2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
 - 2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
 - 3. Test continuity of each circuit.
 - 4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect and Owner before starting the motor(s).
 - 5. Test each motor for proper phase rotation.
 - 6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Enclosed controllers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

- A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.
- C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Architect and Owner before increasing settings.
- D. Set field-adjustable switches and program microprocessors for required start and stop sequences in reduced-voltage solid-state controllers.
- E. Set field-adjustable circuit-breaker trip ranges.

3.7 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.
- B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

END OF SECTION

SECTION 263213
ENGINE GENERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes packaged engine-generator sets for standby power supply with the following features:
 - 1. Diesel engine.
 - 2. Unit-mounted cooling system.
 - 3. Unit-mounted control and monitoring.
 - 4. Performance requirements for sensitive loads.
 - 5. Outdoor enclosure.
- B. Related Sections include the following:
 - 1. Division 26 Section "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.3 DEFINITIONS

- A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 SUBMITTALS

- A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:
 - 1. Thermal damage curve for generator.
 - 2. Time-current characteristic curves for generator protective device.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
 - 2. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

3. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
 4. Wiring Diagrams: Power, signal, and control wiring.
- C. Manufacturer Seismic Qualification Certification: Submit certification that day tank, engine-generator set, batteries, battery racks, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Qualification Data: For installer and manufacturer.
- E. Source quality-control test reports.
1. Certified summary of prototype-unit test report.
 2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
 3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
 4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
 5. Report of sound generation.
 6. Report of exhaust emissions showing compliance with applicable regulations.
 7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
- H. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
1. Maintenance Proximity: Not more than four hours' normal travel time from Installer's place of business to Project site.
 2. Engineering Responsibility: Preparation of data for vibration isolators and seismic restraints of engine skid mounts, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

- B. **Manufacturer Qualifications:** A qualified manufacturer. Maintain, within 200 miles (321 km) of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.
- C. **Testing Agency Qualifications:** An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL), and that is acceptable to authorities having jurisdiction.
 - 1. **Testing Agency's Field Supervisor:** Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- D. **Source Limitations:** Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.
- E. **Electrical Components, Devices, and Accessories:** Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- F. Comply with ASME B15.1.
- G. Comply with NFPA 37.
- H. Comply with NFPA 70.
- I. Comply with NFPA 110 requirements for Level 1 emergency power supply system.
- J. Comply with UL 2200.
- K. **Engine Exhaust Emissions:** Comply with applicable state and local government requirements.
- L. **Noise Emission:** Comply with applicable state and local government requirements for maximum noise level of 72 dB at 10 feet due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

1.6 PROJECT CONDITIONS

- A. **Interruption of Existing Electrical Service:** Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Owner no fewer than three days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Owner's written permission.
- B. **Environmental Conditions:** Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 - 1. Ambient Temperature: Minus 15 to plus 40 deg C.
 - 2. Relative Humidity: 0 to 95 percent.
 - 3. Altitude: Sea level to 4500 feet (1350 m).

1.7 COORDINATION

- A. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 2 years from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

1.10 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
 - 2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
 - 3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Caterpillar; Engine Div.
 - 2. Kohler Co.; Generator Division.
 - 3. Onan/Cummins Power Generation; Industrial Business Group.

2.2 ENGINE-GENERATOR SET

- A. Factory-assembled and -tested, engine-generator set.
- B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
 - 1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.

- C. Capacities and Characteristics:
 - 1. Power Output Ratings: Nominal ratings as indicated.
 - 2. Output Connections: Three-phase, four wire.
 - 3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

- D. Generator-Set Performance:
 - 1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
 - 2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
 - 3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
 - 4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
 - 5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
 - 6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
 - 7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
 - 8. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.
 - a. Provide permanent magnet excitation for power source to voltage regulator.
 - 9. Start Time: Comply with NFPA 110, Type 1, system requirements.

2.3 ENGINE

- A. Fuel: Fuel oil, Grade DF-2.
- B. Rated Engine Speed: 1800 rpm.
- C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm (11.4 m/s).
- D. Lubrication System: The following items are mounted on engine or skid:
 - 1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
 - 2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
 - 3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- E. Engine Fuel System:
 - 1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
 - 2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.

- F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.
- G. Governor: Adjustable isochronous, with speed sensing.
- H. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.
 - 1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
 - 2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 - 3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
 - 4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
 - 5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
 - a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and noncollapsible under vacuum.
 - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
- I. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
 - 1. Minimum sound attenuation of 25 dB at 500 Hz.
 - 2. Sound level measured at a distance of 25 feet (7 m) from exhaust discharge after installation is complete shall be 72 dBA or less.
 - 3. Muffler shall be an insulated pancake type muffler suitable for mounting within the generator enclosure.
- J. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- K. Starting System: 24-V electric, with negative ground.
 - 1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
 - 2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
 - 3. Cranking Cycle: As required by NFPA 110 for system level specified.
 - 4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least three times without recharging.
 - 5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
 - 6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in Part 1 "Project Conditions" Article. Include accessories required to support and fasten batteries in place.
 - 7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
 - 8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:

- a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
- b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
- c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
- d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
- e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
- f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.4 FUEL OIL STORAGE

- A. Comply with NFPA 30.
- B. Base-Mounted Fuel Oil Tank: Factory installed and piped, complying with UL 142 fuel oil tank. Features include the following:
 - 1. Tank level indicator.
 - 2. Capacity: Fuel for 24 hours' continuous operation at 100 percent rated power output plus an additional 4 hours of capacity for exercising the generator (28 hours total capacity).
 - 3. Vandal-resistant fill cap.
 - 4. Containment Provisions: Comply with requirements of authorities having jurisdiction.
 - 5. Contractor shall fill the generator fuel tank to full capacity after testing is complete.

2.5 CONTROL AND MONITORING

- A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.
- B. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.
- C. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:
 - 1. AC voltmeter.
 - 2. AC ammeter.
 - 3. AC frequency meter.
 - 4. DC voltmeter (alternator battery charging).
 - 5. Engine-coolant temperature gage.
 - 6. Engine lubricating-oil pressure gage.

7. Running-time meter.
8. Ammeter-voltmeter, phase-selector switch(es).
9. Generator-voltage adjusting rheostat.
10. Fuel tank derangement alarm.
11. Fuel tank high-level shutdown of fuel supply alarm.
12. Generator overload.

D. Indicating and Protective Devices and Controls:

1. AC voltmeter.
2. AC ammeter.
3. AC frequency meter.
4. DC voltmeter (alternator battery charging).
5. Engine-coolant temperature gage.
6. Engine lubricating-oil pressure gage.
7. Running-time meter.
8. Ammeter-voltmeter, phase-selector switch(es).
9. Generator-voltage adjusting rheostat.
10. Start-stop switch.
11. Overspeed shutdown device.
12. Coolant high-temperature shutdown device.
13. Coolant low-level shutdown device.
14. Oil low-pressure shutdown device.
15. Fuel tank derangement alarm.
16. Fuel tank high-level shutdown of fuel supply alarm.
17. Generator overload.

E. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

F. Connection to Data Link: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication is reserved for connections for data-link transmission of indications to remote data terminals. Data system connections to terminals are covered in Division 26 Section "Electrical Power Monitoring and Control."

G. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.

1. Overcrank shutdown.
2. Coolant low-temperature alarm.
3. Control switch not in auto position.
4. Battery-charger malfunction alarm.
5. Battery low-voltage alarm.

H. Common Remote Audible Alarm: Signal the occurrence of any events listed below without differentiating between event types. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset.

1. Engine high-temperature shutdown.
2. Lube-oil, low-pressure shutdown.
3. Overspeed shutdown.
4. Remote emergency-stop shutdown.
5. Engine high-temperature prealarm.
6. Lube-oil, low-pressure prealarm.
7. Fuel tank, low-fuel level.
8. Low coolant level.

- I. Remote Alarm Annunciator: Comply with NFPA 99. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.
- J. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Generator Circuit Breaker: Molded-case, electronic-trip type; 100 percent rated; complying with UL 489.
 - 1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
 - 2. Trip Settings: Selected to coordinate with generator thermal damage curve.
 - 3. Mounting: Adjacent to or integrated with control and monitoring panel.
- B. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other generator-set protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector shall perform the following functions:
 - 1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
 - 2. Under single or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
 - 3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the generator set.
 - 4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.

2.7 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H or Class F.
- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.
- E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- F. Enclosure: Drip-proof.

- G. Instrument Transformers: Mounted within generator enclosure.
- H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.
 - 1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.
- I. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

2.8 OUTDOOR GENERATOR-SET ENCLOSURE

- A. Description: Vandal-resistant, weatherproof insulated steel housing, wind resistant up to **100 mph (160 km/h)**. Multiple access doors shall be lockable and provide adequate access to components requiring maintenance. Instruments and control shall be mounted within enclosure. In addition the enclosure shall have the following features:
 - 1. Structural Design and Anchorage: Comply with ASCE 7 for wind loads.
 - 2. Hinged Doors: With padlocking provisions.
 - 3. Ventilation: Motorized louvers equipped with bird screen and filter arranged to permit air circulation while excluding exterior dust, birds, and rodents. Louvers shall be electrically held closed and spring opened.
 - 4. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine-generator-set components.
 - 5. Muffler Location: Within enclosure.
 - 6. Sound attenuated to 72-dBA at 21-feet.
- B. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.
 - 1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.
 - 2. Automatic Dampers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.

2.9 MOTORS

- A. General requirements for motors are specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

2.10 VIBRATION ISOLATION DEVICES

- A. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
 - 1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to **1/4-inch- (6-mm-)** thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 - 2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.11 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.12 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
 1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.
- B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
 1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
 2. Full load run.
 3. Maximum power.
 4. Voltage regulation.
 5. Transient and steady-state governing.
 6. Single-step load pickup.
 7. Safety shutdown.
 8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
 9. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.
- B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.
- B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

- C. Install packaged engine generator with restrained spring isolators having a minimum deflection of 1 inch (25 mm) on 4-inch- (100-mm-) high concrete base. Secure sets to anchor bolts installed in concrete bases. Concrete base construction is specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- D. Install Schedule 40, black steel piping with welded joints for cooling water piping between engine-generator set and. Piping materials and installation requirements are specified in Division 23 Section "Hydronic Piping."
- E. Install Schedule 40, black steel piping with welded joints and connect to engine muffler and extend to outside of the enclosure. Piping shall be same diameter as muffler outlet. Flexible connectors and steel piping materials and installation requirements are specified in Division 23 Section "Hydronic Piping."
- F. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.
- G. Fuel: Provide fuel to fill the generator fuel tank to 100% capacity after testing is complete.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in Division 23 Sections. Drawings indicate general arrangement of piping and specialties.
- B. Connect engine exhaust pipe to engine with flexible connector.
- C. Connect fuel piping to engines with a gate valve and union and flexible connector.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 IDENTIFICATION

- A. Identify system components according to Division 23 Section "Identification for HVAC Piping and Equipment" and Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection (except those indicated to be optional) for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
 3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
 - a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
 - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
 - c. Verify acceptance of charge for each element of the battery after discharge.
 - d. Verify that measurements are within manufacturer's specifications.
 4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
 5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
 6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding **40-inch wg (120 kPa)**. Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
 7. Exhaust Emissions Test: Comply with applicable government test criteria.
 8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
 9. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.
 10. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations on the property line, and compare measured levels with required values.
- C. Coordinate tests with tests for transfer switches and run them concurrently.
 - D. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.
 - E. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - H. Remove and replace malfunctioning units and retest as specified above.
 - I. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
 - J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 263600 TRANSFER SWITCHES

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 transfer switches rated 600 V and less, including the following:
 - 1. Remote annunciation systems.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
 - 1. Single-Line Diagram: Show connections between transfer switch, power sources, and load; and show interlocking provisions for each combined transfer switch.
- C. Manufacturer Seismic Qualification Certification: Submit certification that transfer switches accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Features and operating sequences, both automatic and manual.

TRANSFER SWITCHES

263600 – 1

2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain remote annunciators through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NEMA ICS 1.
- D. Comply with NFPA 70.
- E. Comply with NFPA 99.
- F. Comply with NFPA 110.
- G. Comply with UL 1008 unless requirements of these Specifications are stricter.

1.5 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:
 1. Notify Architect no fewer than 7 days in advance of proposed interruption of electrical service.
 2. Do not proceed with interruption of electrical service without Architect's written permission.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Contactor Transfer Switches:
 - a. Caterpillar; Engine Div.
 - b. Emerson; ASCO Power Technologies, LP.
 - c. Generac Power Systems, Inc.

TRANSFER SWITCHES

263600 – 2

- d. GE Zenith Controls.
- e. Kohler Power Systems; Generator Division.
- f. Onan/Cummins Power Generation; Industrial Business Group.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

- A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
 - 1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
- C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- E. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.
- F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
 - 1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
 - 2. Switch Action: Double throw; mechanically held in both directions.
 - 3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.
- G. Neutral Switching. Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.
- H. Neutral Terminal: Solid and fully rated, unless otherwise indicated.
- I. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.
- J. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Division 26 Section "Identification for Electrical Systems."
 - 1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.

2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
- K. Enclosures: General-purpose NEMA 250, Type 3R, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.3 REMOTE ANNUNCIATOR SYSTEM

- A. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches. Annunciation shall include the following:
1. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
 2. Switch position.
 3. Switch in test mode.
 4. Failure of communication link.
- B. Annunciator Panel: LED-lamp type with audible signal and silencing switch.
1. Indicating Lights: Grouped for each transfer switch monitored.
 2. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.
 3. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.
 4. Lamp Test: Push-to-test or lamp-test switch on front panel.

2.4 SOURCE QUALITY CONTROL

- A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Floor-Mounting Switch: Anchor to floor by bolting.
1. Concrete Bases: **4 inches (100 mm)** high, reinforced, with chamfered edges. Extend base no more than **4 inches (100 mm)** in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support. Construct concrete bases according to Division 26 Section "Hangers and Supports for Electrical Systems."
- C. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.

TRANSFER SWITCHES

263600 – 4

- D. Identify components according to Division 26 Section "Identification for Electrical Systems."
- E. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.
 - 2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
 - 3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
 - a. Check for electrical continuity of circuits and for short circuits.
 - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
 - c. Verify that manual transfer warnings are properly placed.
 - d. Perform manual transfer operation.
 - 5. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
 - a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
 - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
 - c. Verify time-delay settings.
 - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
 - e. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
 - f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
 - 6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.

- a. Verify grounding connections and locations and ratings of sensors.
- B. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
 - 1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 2. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 26 43 13

SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. All sections of Division 01, General Requirements, apply to this section.
- B. Coordinate with Commissioning Work. Comply with the requirements of Division 01 Section "General Commissioning Requirements" and Division 26 Section "Electrical Commissioning."

1.2 SUMMARY

- A. Section includes field-mounted SPDs for low-voltage (120V to 600 V) power distribution and control equipment.
- B. Related Requirements:
 - 1. Section 262413 "Switchboards" for factory-installed SPDs.
 - 2. Section 262416 "Panelboards" for factory-installed SPDs.

1.3 DEFINITIONS

- A. Inominal: Nominal discharge current.
- B. MCOV: Maximum continuous operating voltage.
- C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.
- D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.
- E. OCPD: Overcurrent protective device.
- F. SCCR: Short-circuit current rating.
- G. SPD: Surge protective device.
- H. VPR: Voltage protection rating.

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 260500.1.5B.
- B. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

C. Field quality-control reports.

D. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For SPDs to include in maintenance manuals.

1.6 SUBSTITUTIONS

A. Submit request for substitution of materials as part of product submittal, in accordance with the requirements of Division 01.

1.7 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum 15 years' experience.

1.8 WARRANTY

A. Comply with the requirements outlined in Section 26 05 00, "Common Work Results for Electrical."

PART 2 - PRODUCTS

2.1 GENERAL SPD REQUIREMENTS

A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Comply with UL 1449.

D. MCOV of the SPD shall be the nominal system voltage.

2.2 SERVICE ENTRANCE SUPPRESSOR

A. Manufacturers: Subject to compliance with requirements, provide products by one the following:

1. ABB.
2. Advanced Protection Technologies Inc. (APT).
3. Eaton Corporation.
4. Emerson Electric Co.
5. GE Zenith Controls.

6. LEA International; Protection Technology Group.
7. Leviton Manufacturing Co., Inc.
8. PowerLogics, Inc.
9. Square D: Schneider Electric.

- B. SPDs: Comply with UL 1449, Type 1.
- C. Source Limitations: Obtain all SPDs for all electrical distribution equipment from the same manufacturer.
- D. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 240kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
- E. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, three-phase, four-wire circuits shall not exceed the following:
 1. Line to Neutral: 1200 V for 480Y/277 V.
 2. Line to Ground: 1200 V for 480Y/277 V.
 3. Line to Line: 1800 V for 480Y/277 V.
- F. SCCR: Equal or exceed 200kA.

2.3 PANEL SUPPRESSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. ABB.
 2. Advanced Protection Technologies Inc. (APT).
 3. Eaton Corporation.
 4. Emerson Electric Co.
 5. GE Zenith Controls.
 6. LEA International; Protection Technology Group.
 7. Leviton Manufacturing Co., Inc.
 8. PowerLogics, Inc.
 9. Square D: Schneider Electric.
- B. SPDs: Comply with UL 1449, Type 2.
 1. Include LED indicator lights for power and protection status.
- C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 120 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
- D. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:
 1. Line to Neutral: 800 V for 480Y/277 V, 400 V for 208Y/120 V.
 2. Line to Ground: 800 V for 480Y/277 V, 400 V for 208Y/120 V.
 3. Neutral to Ground: 800 V for 480Y/277 V, 400 V for 208Y/120 V.
 4. Line to Line: 800 V for 480Y/277 V, 400 V for 208Y/120 V.
- E. SCCR: Equal or exceed 200kA.

2.4 ENCLOSURES

- A. Indoor Enclosures: NEMA 250, Type 1.
- B. Outdoor Enclosures: NEMA 250, Type 3R.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.
- C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
- D. Use crimped connectors and splices only. Wire nuts are unacceptable.
- E. Wiring:
 - 1. Power Wiring: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
 - 2. Controls: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.
 - 1. Compare equipment nameplate data for compliance with Drawings and Specifications.
 - 2. Inspect anchorage, alignment, grounding, and clearances.
 - 3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.
- B. An SPD will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

- A. Complete startup checks according to manufacturer's written instructions.
- B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.
- C. Energize SPDs after power system has been energized, stabilized, and tested.
- D. Train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION

SECTION 265100
INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

- 1. Interior lighting fixtures, lamps, and ballasts.
- 2. Emergency lighting units.
- 3. Exit signs.
- 4. Lighting fixture supports.

- B. Related Sections include the following:

- 1. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors, except for self-contained daylight responsive luminaires, which are specified herein.
- 2. Division 26 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.

1.3 DEFINITIONS

- A. BF: Ballast factor.
- B. CRI: Color-rendering index.
- C. CU: Coefficient of utilization.
- D. HID: High-intensity discharge.
- E. LER: Luminaire efficacy rating.
- F. Luminaire: Complete lighting fixture, including ballast housing if provided.
- G. RCR: Room cavity ratio.

1.4 SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
 2. Emergency lighting units including battery and charger.
 3. Ballast.
 4. Energy-efficiency data.
 5. Air and Thermal Performance Data: For air-handling lighting fixtures. Furnish data required in "Submittals" Article in Division 23 Section "Diffusers, Registers, and Grilles."
 6. Sound Performance Data: For air-handling lighting fixtures. Indicate sound power level and sound transmission class in test reports certified according to standards specified in Division 23 Section "Diffusers, Registers, and Grilles."
 7. Life, output, and energy-efficiency data for lamps.
 8. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
 - a. For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by the manufacturer.
 - b. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.
- B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.
1. Wiring Diagrams: Power and control wiring.
- C. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
1. Lighting fixtures.
 2. Suspended ceiling components.
 3. Structural members to which suspension systems for lighting fixtures will be attached.
 4. Other items in finished ceiling including the following:
 - a. Air outlets and inlets.
 - b. Speakers.
 - c. Sprinklers.
 - d. Smoke and fire detectors.
 - e. Occupancy sensors.
 - f. Access panels.
 5. Perimeter moldings.
- D. Samples for Verification: Interior lighting fixtures designated for sample submission in Interior Lighting Fixture Schedule. Each sample shall include the following:
1. Lamps: Specified units installed.
 2. Accessories: Cords and plugs.
- E. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.
- F. Qualification Data: For agencies providing photometric data for lighting fixtures.

- G. Field quality-control test reports.
- H. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
- I. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NFPA 70.
- E. FMG Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.
- F. Mockups: Provide interior lighting fixtures for room or module mockups, complete with power and control connections.
 - 1. Obtain Architect's approval of fixtures for mockups before starting installations.
 - 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 3. Approved fixtures in mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 WARRANTY

- A. Special Warranty for Ballasts: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Electronic Ballasts: Five years from date of Substantial Completion.
- B. Special Warranty for T5HO and T8 Fluorescent Lamps: Manufacturer's standard form, made out to Owner and signed by lamp manufacturer agreeing to replace lamps that fail in materials

or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: One year(s) from date of Substantial Completion.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
 2. Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
 3. Ballasts: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
 4. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
- B. In Interior Lighting Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.
- C. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
- D. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.
- E. Metal Parts: Free of burrs and sharp corners and edges.
- F. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to

prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

H. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.
4. Laminated Silver Metallized Film: 90 percent.

I. Plastic Diffusers, Covers, and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness: At least **0.125 inch (3.175 mm)** minimum unless different thickness is indicated.
 - b. UV stabilized.
2. Glass: Annealed crystal glass, unless otherwise indicated.

2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

A. Electronic Ballasts: Comply with ANSI C82.11; programmed-start type, unless otherwise indicated, and designed for type and quantity of lamps served. Ballasts shall be designed for full light output unless dimmer or bi-level control is indicated.

1. Sound Rating: A.
2. Total Harmonic Distortion Rating: Less than 20 percent.
3. Transient Voltage Protection: IEEE C62.41, Category A or better.
4. Operating Frequency: 20 kHz or higher.
5. Lamp Current Crest Factor: 1.7 or less.
6. BF: 0.71 for T8.
7. Power Factor: 0.98 or higher.
8. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C 82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.

B. Electronic Programmed-Start Ballasts for T5HO Lamps: Comply with ANSI C82.11 and the following:

1. Lamp end-of-life detection and shutdown circuit for T5 diameter lamps.
2. Automatic lamp starting after lamp replacement.
3. Sound Rating: A.
4. Total Harmonic Distortion Rating: Less than 20 percent.
5. Transient Voltage Protection: IEEE C62.41, Category A or better.
6. Operating Frequency: 20 kHz or higher.
7. Lamp Current Crest Factor: 1.7 or less.
8. BF: 0.95 or higher, unless otherwise indicated.
9. Power Factor: 0.98 or higher.

C. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.

1. Dimming Range: 100 to 5 percent of rated lamp lumens.
2. Ballast Input Watts: Can be reduced to 20 percent of normal.

3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated, 4 wire (0-10 vdc preferred)
 4. Photo-responsive luminaires shall include integral photocell, powersupply, and dimming ballast for 100%-30% dimming range in automatic response to presence or absence of daylight.
 5. Larger scaled areas with external photocell control and group photocell control shall operate in an identical manner, with common dimming signal.
- D. Electromagnetic Ballasts: Comply with ANSI C82.1; energy saving, high-power factor, Class P, and having automatic-reset thermal protection.
1. Ballast Manufacturer Certification: Indicated by label.
- E. Single Ballasts for Multiple Lighting Fixtures: Factory-wired with ballast arrangements and bundled extension wiring to suit final installation conditions without modification or rewiring in the field.
- F. Ballasts for Low-Temperature Environments:
1. Temperatures 0 Deg F (Minus 17 Deg C) and Higher: Electronic type rated for 0 deg F (minus 17 deg C) starting and operating temperature with indicated lamp types.
 2. Temperatures Minus 20 Deg F (Minus 29 Deg C) and Higher: Electromagnetic type designed for use with indicated lamp types.
- G. Ballasts for Low Electromagnetic-Interference Environments: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for consumer equipment.

2.4 BALLASTS FOR COMPACT FLUORESCENT LAMPS

- A. Description: Electronic programmed rapid-start type, complying with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:
1. Lamp end-of-life detection and shutdown circuit.
 2. Automatic lamp starting after lamp replacement.
 3. Sound Rating: A.
 4. Total Harmonic Distortion Rating: Less than 20 percent.
 5. Transient Voltage Protection: IEEE C62.41, Category A or better.
 6. Operating Frequency: 20 kHz or higher.
 7. Lamp Current Crest Factor: 1.7 or less.
 8. BF: 0.95 or higher, unless otherwise indicated.
 9. Power Factor: 0.98 or higher.
 10. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
 11. Ballast Case Temperature: 75 deg C, maximum.
- B. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.
1. Dimming Range: 100 to 5 percent of rated lamp lumens.
 2. Ballast Input Watts: Can be reduced to 20 percent of normal.
 3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated, 4 wire (0-10 vdc preferred)

2.5 BALLASTS FOR HID LAMPS

- A. Electronic Ballast for Metal-Halide Lamps: Include the following features unless otherwise indicated:
1. Lamp end-of-life detection and shutdown circuit.
 2. Sound Rating: A.
 3. Total Harmonic Distortion Rating: Less than 15 percent.
 4. Transient Voltage Protection: IEEE C62.41, Category A or better.
 5. Lamp Current Crest Factor: 1.5 or less.
 6. Power Factor: .90 or higher.
 7. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
 8. Protection: Class P thermal cutout.
 9. Retain subparagraph and associated subparagraphs below for bi-level ballasts.

2.6 EXIT SIGNS

- A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.
 - a. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
 - b. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is announced by an integral audible alarm and flashing red LED.

2.7 FLUORESCENT LAMPS

- A. Low-Mercury Lamps: Comply with EPA's toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.
- B. T8 rapid-start low-mercury lamps, rated 32 W maximum, nominal length of 48 inches (1220 mm), 3100 initial lumens (minimum), CRI 75 (minimum), color temperature 4100 K, and average rated life 20,000 hours, unless otherwise indicated. Full wattage for dimmed applications.
- C. T5HO rapid-start, high-output low-mercury lamps, rated 54 W maximum, nominal length of 45.2 inches (1150 mm), 5000 initial lumens (minimum), CRI 85 (minimum), color temperature 4100 K, and average rated life of 20,000 hours, unless otherwise indicated.
- D. Compact Fluorescent Lamps: 4-Pin, low mercury, CRI 80 (minimum), color temperature 4100 K, average rated life of 10,000 hours at 3 hours operation per start, and suitable for use with dimming ballasts, unless otherwise indicated.
1. 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).
 2. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).
 3. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
 4. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).

5. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).
6. 55 W: T4, triple tube, rated 4300 initial lumens (minimum).

2.8 HID LAMPS

- A. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and color temperature 4000 K.

2.9 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: **1/2-inch (13-mm)** steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, **1/2-inch (13-mm)** steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, **12 gage (2.68 mm)**.
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, **12 gage (2.68 mm)**.
- F. Rod Hangers: **3/16-inch (5-mm)** minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- B. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.
 1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than **6 inches (150 mm)** from lighting fixture corners.
 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two **3/4-inch (20-mm)** metal channels spanning and secured to ceiling tees.
 4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- C. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

D. Air-Handling Lighting Fixtures: Install with dampers closed and ready for adjustment.

E. Adjust aimable lighting fixtures to provide required light intensities.

F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION

SECTION 265600
EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Exterior luminaires with lamps and ballasts.
 - 2. Luminaire-mounted photoelectric relays.
 - 3. Poles and accessories.
- B. Related Sections include the following:
 - 1. Division 26 Section "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.3 DEFINITIONS

- A. CRI: Color-rendering index.
- B. HID: High-intensity discharge.
- C. Luminaire: Complete lighting fixture, including ballast housing if provided.
- D. Pole: Luminaire support structure, including tower used for large area illumination.
- E. Standard: Same definition as "Pole" above.

1.4 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

- A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-4.
- B. Live Load: Single load of 500 lbf (2224 N), distributed as stated in AASHTO LTS-4.
- C. Ice Load: Load of 3 lbf/sq. ft. (143.6 Pa), applied as stated in AASHTO LTS-4.
- D. Wind Load: Pressure of wind on pole and luminaire, calculated and applied as stated in AASHTO LTS-4.
 - 1. Wind speed for calculating wind load for poles 50 feet (15 m) or less in height is 110 mph (177 km/h).

1.5 SUBMITTALS

- A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
 2. Details of attaching luminaires and accessories.
 3. Details of installation and construction.
 4. Luminaire materials.
 5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.
 - a. For indicated luminaires, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
 - b. Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
 6. Photoelectric relays.
 7. Ballasts, including energy-efficiency data.
 8. Lamps, including life, output, and energy-efficiency data.
 9. Materials, dimensions, and finishes of poles.
 10. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
 11. Anchor bolts for poles.
 12. Manufactured pole foundations.
- B. Shop Drawings:
1. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
 2. Design calculations, certified by a qualified professional engineer, indicating strength of screw foundations and soil conditions on which they are based.
 3. Wiring Diagrams: Power and control wiring.
- C. Samples for Verification: For products designated for sample submission in Exterior Lighting Device Schedule. Each sample shall include lamps and ballasts.
- D. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4 and that load imposed by luminaire has been included in design.
- E. Qualification Data: For agencies providing photometric data for lighting fixtures.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For luminaires and poles to include in emergency, operation, and maintenance manuals.
- H. Warranty: Special warranty specified in this Section.

1.6 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with IEEE C2, "National Electrical Safety Code."
- E. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Package aluminum poles for shipping according to ASTM B 660.
- B. Store poles on decay-resistant-treated skids at least **12 inches (300 mm)** above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- C. Handle wood poles so they will not be damaged. Do not use pointed tools that can indent pole surface more than **1/4 inch (6 mm)** deep. Do not apply tools to section of pole to be installed below ground line.
- D. Retain factory-applied pole wrappings on fiberglass and laminated wood poles until right before pole installation. Handle poles with web fabric straps.
- E. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.
 - 1. Warranty Period for Luminaires: Five years from date of Substantial Completion.
 - 2. Warranty Period for Metal Corrosion: Five years from date of Substantial Completion.
 - 3. Warranty Period for Color Retention: Five years from date of Substantial Completion.
 - 4. Warranty Period for Lamps: Replace lamps and fuses that fail within 12 months from date of Substantial Completion; furnish replacement lamps and fuses that fail within the second 12 months from date of Substantial Completion.
 - 5. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than three years from date of Substantial Completion.

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Glass and Plastic Lenses, Covers, and Other Optical Parts: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Ballasts: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 4. Globes and Guards: 10 for every 20 of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
- B. In Exterior Lighting Device Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - 2. Basis of Design Product: The design of each item of exterior luminaire and its support is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 LUMINAIRES, GENERAL REQUIREMENTS

- A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
- B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.
- G. Exposed Hardware Material: Stainless steel.

- H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.
- J. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
- K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.
- M. Factory-Applied Finish for Steel luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
 - 2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
 - a. Color: As selected from manufacturer's standard catalog of colors.
 - b. Color: Match Architect's sample of manufacturer's standard color.
 - c. Color: As selected by Architect from manufacturer's full range.
- N. Factory-Applied Finish for Aluminum luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 - 2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
 - 3. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
 - 4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; 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.
 - a. Color: As selected by the Architect.

2.3 BALLASTS FOR HID LAMPS

- A. Comply with ANSI C82.4 and UL 1029 and capable of open-circuit operation without reduction of average lamp life. Include the following features, unless otherwise indicated:
1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
 2. Minimum Starting Temperature: **Minus 22 deg F (Minus 30 deg C)**.
 3. Normal Ambient Operating Temperature: **104 deg F (40 deg C)**.
 4. Ballast Fuses: One in each ungrounded power supply conductor. Voltage and current ratings as recommended by ballast manufacturer.

2.4 HID LAMPS

- A. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and color temperature 4000 K.

2.5 POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS

- A. Structural Characteristics: Comply with AASHTO LTS-4.
1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in Part 1 "Structural Analysis Criteria for Pole Selection" Article, with a gust factor of 1.3.
 2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.
- B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.
- C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
1. Materials: Shall not cause galvanic action at contact points.
 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication, unless stainless-steel items are indicated.
 3. Anchor-Bolt Template: Plywood or steel.
- D. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."
- E. Power-Installed Screw Foundations: Factory fabricated by pole manufacturer, with structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole base flange and strength required to support pole, luminaire, and accessories.
- F. Breakaway Supports: Frangible breakaway supports, tested by an independent testing agency acceptable to authorities having jurisdiction, according to AASHTO LTS-4.

2.6 STEEL POLES

- A. Poles: Comply with ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psig (317 MPa); 1-piece construction up to 40 feet (12 m) in height with access handhole in pole wall.
 - 1. Shape: Square, straight.
 - 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- B. Steel Mast Arms: Single-arm type, continuously welded to pole attachment plate. Material and finish same as pole.
- C. Brackets for Luminaires: Detachable, cantilever, without underbrace.
 - 1. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel bolts.
 - 2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire.
 - 3. Match pole material and finish.
- D. Steps: Fixed steel, with nonslip treads, positioned for 15-inch (381-mm) vertical spacing, alternating on opposite sides of pole; first step at elevation 10 feet (3 m) above finished grade.
- E. Intermediate Handhole and Cable Support: Weathertight, 3-by-5-inch (76-by-127-mm) handhole located at midpoint of pole with cover for access to internal welded attachment lug for electric cable support grip.
- F. Grounding and Bonding Lugs: Welded 1/2-inch (13-mm) threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- G. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported cable times a 5.0 safety factor.
- H. Platform for Lamp and Ballast Servicing: Factory fabricated of steel with finish matching that of pole.
- I. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.
- J. Galvanized Finish: After fabrication, hot-dip galvanize complying with ASTM A 123/A 123M.
- K. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
 - 2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
 - 3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

- a. Color: As indicated by manufacturer's designations.

2.7 POLE ACCESSORIES

- A. Minimum 1800-W transformer, protected by replaceable fuses, mounted behind access cover.
- B. Base Covers: Manufacturers' standard metal units, arranged to cover pole's mounting bolts and nuts. Finish same as pole.
- C. Transformer Type Base: Same material and color as pole. Coordinate dimensions to suit pole's base flange and accept indicated accessories.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

- A. Install lamps in each luminaire.
- B. Fasten luminaire to indicated structural supports.
 - 1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources.

3.2 POLE INSTALLATION

- A. Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.
- B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features, unless otherwise indicated on Drawings:
 - 1. Fire Hydrants and Storm Drainage Piping: **60 inches (1520 mm)**.
 - 2. Water, Gas, Electric, Communication, and Sewer Lines: **10 feet (3 m)**.
 - 3. Trees: **15 feet (5 m)**.
- C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
 - 1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
 - 2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
 - 3. Install base covers, unless otherwise indicated.

4. Use a short piece of **1/2-inch- (13-mm-)** diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
- E. Embedded Poles with Tamped Earth Backfill: Set poles to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height.
1. Dig holes large enough to permit use of tampers in the full depth of hole.
 2. Backfill in **6-inch (150-mm)** layers and thoroughly tamp each layer so compaction of backfill is equal to or greater than that of undisturbed earth.
- F. Embedded Poles with Concrete Backfill: Set poles in augered holes to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height.
1. Make holes **6 inches (150 mm)** in diameter larger than pole diameter.
 2. Fill augered hole around pole with air-entrained concrete having a minimum compressive strength of **3000 psi (20 MPa)** at 28 days, and finish in a dome above finished grade.
 3. Use a short piece of **1/2-inch- (13-mm-)** diameter pipe to make a drain hole through concrete dome. Arrange to drain condensation from interior of pole.
 4. Cure concrete a minimum of 72 hours before performing work on pole.
- G. Poles and Pole Foundations Set in Concrete Paved Areas: Install poles with minimum of **6-inch- (150-mm-)** wide, unpaved gap between the pole or pole foundation and the edge of adjacent concrete slab. Fill unpaved ring with pea gravel to a level **1 inch (25 mm)** below top of concrete slab.
- H. Raise and set poles using web fabric slings (not chain or cable).

3.3 BOLLARD LUMINAIRE INSTALLATION

- A. Align units for optimum directional alignment of light distribution.
- B. Install on concrete base with top **4 inches (100 mm)** above finished grade or surface at bollard location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 03 Section "Cast-in-Place Concrete."

3.4 INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LUMINAIRES

- A. Install on concrete base with top **4 inches (100 mm)** above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 03 Section "Cast-in-Place Concrete."

3.5 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems." In concrete foundations, wrap conduit with **0.010-inch- (0.254-mm-)** thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.6 GROUNDING

- A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
 - 1. Install grounding electrode for each pole, unless otherwise indicated.
 - 2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

- B. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
 - 1. Install grounding electrode for each pole.
 - 2. Install grounding conductor and conductor protector.
 - 3. Ground metallic components of pole accessories and foundations.

3.7 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

- B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.
 - 1. Verify operation of photoelectric controls.

- C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain luminaire lowering devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 271100

TELECOMMUNICATIONS PATHWAYS AND SPACES

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. Telecommunications vertical and horizontal pathways.
2. Backboards and mounting elements.
3. Telecommunications equipment racks and cabinets.
4. Telecommunications service entrance pathways.
5. Grounding.

B. Related Sections:

1. Division 27 Section "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
2. Division 27 Section "Communications Horizontal Cabling" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

- A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- B. BICSI: Building Industry Consulting Service International.
- C. LAN: Local area network.
- D. RCDD: Registered Communications Distribution Designer.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Floor-mounted cabinets and cable pathways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7, (Zone 4).
 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
 - 3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.
- C. Qualification Data: For each qualified layout technician, installation supervisor, and field inspector.
- D. Seismic Qualification Certificates: For floor-mounted cabinets, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions. Base certification on the maximum number of components capable of being mounted in each rack type. Identify components on which certification is based.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of an RCDD.
 - 2. Installation Supervision: Installation shall be under the direct supervision of a Registered Technician (BICSI), who shall be present at all times when Work of this Section is performed at Project site.
 - 3. Field Inspector: Currently registered by BICSI as an RCDD to perform the on-site inspection.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Telecommunications Pathways and Spaces: Comply with ANSI/TIA/EIA-569-B.
- D. Grounding: Comply with ANSI-J-STD-607-A.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install equipment frames and cable trays until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and associated construction work on the subfloor and raised floor supports is substantially complete.

1.8 COORDINATION

- A. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
 - 1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
 - 2. Record agreements reached in meetings and distribute them to other participants.
 - 3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
 - 4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.
- B. Coordinate location of power raceways and receptacles with associated locations of communications equipment requiring electrical power to operate.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. General Requirements: Comply with ANSI/TIA/EIA-569-B.
- B. Cable Support (Free Space): Cable installation of less than 5 cables shall not require basket cable tray management, but shall require bundling of cables with approved Velcro fasteners for orderly layout..
- C. Cable Trays:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cablofil Inc.
 - b. Cooper B-Line, Inc.
 - c. GS Metals Corp.
 - .
 - 2. Cable Tray Materials: Metal, suitable for indoors and protected against corrosion by electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than 0.000472 inch (0.012 mm) thick.

- a. Basket Cable Trays: Provide trays widths as noted - 2, 6, and/or 12 inches - wide and 1 inch deep. Wire mesh spacing shall not exceed 2 by 4 inches.
- D. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems".
- E. Conduit Sleeves: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems".
- F. Conduit and Boxes (Wireless Access Points): Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems". Provide in an accessible location above the ceiling a single gang junction box for outlet mounting, and extend the conduit to the nearest cable tray.

2.2 BACKBOARDS

- A. Backboards: Provide plywood, fire-retardant treated, 3/4 by 48 by 96 inches, on at least two of the full non-door walls of each telecommunications room, or as noted. Comply with requirements for plywood backing panels specified in Division 06 Section "Rough Carpentry."

2.3 EQUIPMENT FRAMES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ADC.
 - 2. AMP; a Tyco International Ltd. company.
 - 3. Cooper B-Line, Inc.
 - 4. Hubbell Premise Wiring.
 - 5. Leviton Voice & Data Division.
 - 6. Middle Atlantic Products, Inc.
 - 7. Nordex/CDT; a subsidiary of Cable Design Technologies.
 - 8. Ortronics, Inc.
 - 9. Panduit Corp.
 - 10. Siemon Co. (The).
- B. General Frame Requirements:
 - 1. Distribution Frames: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
 - 2. Module Dimension: Width compatible with EIA 310 standard, 19-inch panel mounting.
 - 3. Finish: Manufacturer's standard, baked-polyester powder coat.
- C. Floor-Mounted Racks: Modular-type, steel or aluminum construction.
 - 1. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug, and a power strip.
 - 2. Baked-polyester powder coat finish.
- D. Cable Management for Equipment Frames:

1. Metal, with integral wire retaining fingers.
2. Baked-polyester powder coat finish.
3. Vertical cable management panels shall have front and rear channels, with covers.
4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

2.4 POWER STRIPS

A. Power Strips: Comply with UL 1363.

1. Rack mounting.
2. Eight, 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles.
3. LED indicator lights for power and protection status.
4. LED indicator lights for reverse polarity and open outlet ground.
5. Circuit Breaker and Thermal Fusing: When protection is lost, circuit opens and cannot be reset.
6. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
7. Cord connected with 6-foot line cord.
8. Rocker-type on-off switch, illuminated when in on position.
9. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all 3 modes shall be not more than 330 V.

2.5 GROUNDING

A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.

B. Telecommunications Main Ground Bus Bar:

1. Connectors: Mechanical type, cast silicon bronze, solderless exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide with 9/32-inch holes spaced 1-1/8 inches apart.
3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

C. Comply with ANSI-J-STD-607-A.

2.6 LABELING

A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

- A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and any associated termination housing when so directed by service provider.
- B. Install underground pathways complying with recommendations in TIA/EIA-569-B, "Entrance Facilities" Article.

3.2 INSTALLATION

- A. Install underground entrance pathway complying with Division 26 Section "Raceway and Boxes for Electrical Systems." Comply with NECA 1.
- B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.
- C. Cable Trays: Provide overhead cable runway (ladder rack) as noted. Comply with NEMA VE 2 and TIA/EIA-569-B.
- D. Bundle, wrap, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install management bars and distribution spools.

3.3 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping." Comply with TIA/EIA-569-B, "Firestopping."
- B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.4 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.
 - 1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

3.5 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
- B. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- C. See Section 271300 "Communications Horizontal Cabling" for additional identification requirements. See Evaluations for discussion of TIA/EIA standard as it applies to this Section.
- D. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 4 level of administration, including optional identification requirements of this standard.
- E. Labels shall be preprinted or computer-printed type.

END OF SECTION

SECTION 271300

COMMUNICATIONS BACKBONE CABLING

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. Pathways.
2. UTP cable, multipair.
3. 8.3 micrometer, singlemode optical fiber cabling.
4. Cable connecting hardware, termination panels, and cross-connects.
5. Cabling identification products.

B. Related Sections:

1. Division 27 Section "Communications Horizontal Cabling" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- C. EMI: Electromagnetic interference.
- D. IDC: Insulation displacement connector.
- E. LAN: Local area network.
- F. RCDD: Registered Communications Distribution Designer.
- G. UTP: Unshielded twisted pair.

1.4 OUTSIDE PLANT CABLING DESCRIPTION

- A. Outside plant cabling system shall provide interconnections from the closest point of presence (campus network) to the entrance facility of the new building. Cabling system consists of backbone cables, mechanical terminations, lightning and surge protection modules, backboards and interconnecting hardware.

- B. The work shall consist of providing, testing and making operational the cabling, interconnecting hardware and protection modules necessary to form a complete outside plant telecommunications system for continuous use.

1.5 PERFORMANCE REQUIREMENTS

- A. General Performance: Backbone cabling system shall comply with transmission standards in TIA/EIA-568-B.1, 2, and 3 when tested according to test procedures of this standard.

1.6 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For all cable, include the following installation data for each type used:
 - a. Nominal OD.
 - b. Minimum bending radius.
 - c. Maximum pulling tension.
- B. Shop Drawings:
 - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 - 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
 - 3. Cabling administration drawings and printouts.
 - 4. Wiring diagrams to show typical wiring schematics including the following:
 - a. Cross-connects.
 - b. Patch panels.
 - c. Patch cords.
 - 5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
 - 6. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
 - a. Vertical and horizontal offsets and transitions.
 - b. Clearances for access above and to side of cable trays.
 - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
 - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.
- C. Qualification Data: For all qualified layout technicians, installation supervisors, and field inspectors.
- D. Source quality-control reports.
- E. Field quality-control reports.
- F. Maintenance Data: For splices and connectors to include in maintenance manuals.
- G. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field testing program development by an RCDD.
 2. Installation Supervision: Installation shall be under the direct supervision of a Registered Technician (BICSI), who shall be present at all times when Work of this Section is performed at Project site.
 3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- B. Testing Agency Qualifications: An NRTL.
 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
- E. Grounding: Comply with ANSI-J-STD-607-A.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set.
 2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.
 3. Test each pair of UTP cable for open and short circuits.

1.9 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

1.10 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Furnish five percent of total quantity provided for each component, minimum of one, if less than one.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-A.
- B. Existing Duct and Manholes: New connecting duct shall be installed from the new facility to the closest existing manhole for delivery of cable backbone to the closest point of presence. Coordinate with Base Comm Squad personnel for installation of cable.
- C. Splicing Closures:
 - 1. Copper Cabling: Closures shall be pre-formed stainless steel splice cases supplying structural strength necessary to pass the mechanical and electrical requirements in a vault or manhole environment. No encapsulating compound shall be used. Provide splice cases in accordance with RUS Bul 345-72 and RUS Bul 1753F-401.
 - 2. Fiber Optic Cabling: In addition to the properties listed above for copper cabling, fiber splice closures shall also be suitable to house fiber splice organizers within the protective housing. Physically protect each fiber optic splice by a splice kit specially designed for the splice.
- D. Conduit: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems."
- E. Building Protector Assemblies:
 - 1. Provide Marconi gas tube protected assembly, Model 710/66B.

2.2 BACKBOARDS

- A. Backboards: Plywood, CD grade, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements in Division 06 Section "Rough Carpentry" for plywood backing panels.

2.3 UTP CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
 - 1. Belden CDT Inc.; Electronics Division.
 - 2. Berk-Tek; a Nexans company.
 - 3. CommScope, Inc.
 - 4. Mohawk; a division of Belden CDT.
 - 5. Superior Essex Inc.
 - 6. SYSTIMAX Solutions; a CommScope Inc. brand.
 - 7. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

- B. Description: 100-ohm, multipair UTP (quantity as noted), formed into 25-pair binder groups covered with a corrugated copper or plastic coated aluminum shield, and an overall extruded jacket.
1. Comply with ICEA S-90-661 for mechanical properties. Comply with ICEA S-99-689 for filled cable requirements.
 2. Comply with TIA/EIA-568-B.1 for performance specifications.
 3. Comply with TIA/EIA-568-B.2, Category 3.
 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
 - a. Communications, Riser Rated: Type CMR, complying with NFPA 262.

2.4 UTP CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hubbell Premise Wiring..
 2. Leviton Voice & Data Division.
 3. Panduit Corp.
 4. Siemon Co. (The).
 5. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
- B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- C. Connecting Blocks: 110-style IDC for Category 3. Provide blocks for the number of cables terminated on the block, plus 10 percent spare. Integral with connector bodies, including plugs and jacks where indicated.
- D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
1. Number of Terminals per Field: One for each conductor in assigned cables.
- E. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

2.5 OPTICAL FIBER CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Berk-Tek; a Nexans company.
 2. CommScope, Inc.
 3. Corning Cable Systems.
 4. Mohawk; a division of Belden CDT.
 5. Superior Essex Inc.
 6. SYSTIMAX Solutions; a CommScope Inc. brand.
 7. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

- B. Description: Singlemode 8.3/125 micrometer, 12 fiber, loose buffer, optical fiber cable.
 - 1. Comply with ICEA S-83-596 for mechanical properties.
 - 2. Comply with TIA/EIA-568-B.3 for performance specifications.
 - 3. Provide cable with strength members with sufficient tensile strength for installation and residual related loads to meet the applicable performance requirements in accordance with ICEA S-87-640.
 - 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - a. Riser Rated, Nonconductive: Type OFNR, complying with NFPA 262.
- C. Jacket:
 - 1. Jacket Color: Yellow.
 - 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
 - 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals.

2.6 OPTICAL FIBER CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Berk-Tek; a Nexans company.
 - 2. Corning Cable Systems.
 - 3. Hubbell Premise Wiring.
 - 4. Siemon Co. (The).
 - 5. Systimax
 - 6. CommScope
 - 7. AMP
- B. Cross-Connects and Termination Panels: Modular panels housing multiple-numbered, duplex cable connectors.
 - 1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.
- C. Jumper Cords: Factory-made, dual-fiber cables in 60-inch lengths.
- D. Cable Connecting Hardware:
 - 1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
 - 2. Quick-connect, simplex and duplex, Type ST connectors. Insertion loss not more than 0.75 dB.

2.7 GROUNDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.
- B. Comply with ANSI-J-STD-607-A.

2.8 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.9 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test cables on reels according to TIA/EIA-568-B.1.
- C. Factory test UTP cables according to TIA/EIA-568-B.2.
- D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.
- E. Cable will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

- A. Coordinate installation of outside cabling with the Base Communications Squadron with respect to the protectors and demarcation point in the new facility.

3.2 CABLE INSTALLATION

- A. Install all outside plant cabling and protection components in accordance with manufacturer's instructions, IEEE C2, NFPA 70, and ANSI TIA standards. Provide all necessary interconnections, services, and adjustments required for a complete and operable telecommunications system.
- B. Avoid damage to cables in setting up pulling apparatus or in placing tools or hardware. Do not place cables in ducts other than those indicated without prior written approval of the Contracting Officer.
- C. Cable Installation in Manholes. Do not install cabling using the shortest path, but route along those walls providing the longest route and the maximum spare cable lengths. Form cables to closely parallel walls, not to interfere with duct entrances, and support cables on brackets and cable insulators at a maximum of 4 feet. In existing manholes where new ducts are terminated, and where new cables are to be installed, modify the existing installation of cables, supports, and grounding as required with cables arranged and supported as specified for new cables. Identify each cable with corrosion-resistant embossed metal tags.

3.3 INSTALLATION OF PATHWAYS

- A. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- B. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- C. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- D. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.4 CABLE TERMINATION

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 - 1. Comply with TIA/EIA-568-B.1.
 - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 - 3. For UTP cable, install 110-style IDC termination hardware unless otherwise indicated.
 - 4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 - 5. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
 - 6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 - 7. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.
 - 8. Not Used.
 - 9. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. UTP Cable Installation:
 - 1. Comply with TIA/EIA-568-B.2.
- D. Optical Fiber Cable Installation:
 - 1. Comply with TIA/EIA-568-B.3.
 - 2. Cable shall be terminated on connecting hardware that is rack or cabinet mounted.
- E. Separation from EMI Sources:
 - 1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
 - 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.

- b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
- a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
- a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.

3.5 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping." "Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.7 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
 - 1. Administration Class: 2.
 - 2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

- B. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- C. See Division 27 Section "Communications Horizontal Cabling" for additional identification requirements. See Evaluations for discussion about TIA/EIA standard as it applies to this Section. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration.
- D. Cable and Wire Identification:
 - 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 - 3. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware.
- E. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA 606-A, for the following:
 - 1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Visually inspect UTP and optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 3. Test UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - 4. Optical Fiber Cable Tests:
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

- b. Link End-to-End Attenuation Tests:
 - 1) Horizontal and multimode backbone link measurements: Test at 1310 and 1550 nm in both directions according to ANSI/TIA/EIA 568-B standards
 - 2) Attenuation test results for outside plant links shall be less than 2.0 dB.
- D. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- E. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
- F. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

END OF SECTION

SECTION 271500

COMMUNICATIONS HORIZONTAL CABLING

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. Pathways.
2. UTP cabling.
3. Cable connecting hardware, patch panels, and cross-connects.
4. Telecommunications outlet/connectors.
5. Cabling system identification products.
6. Cable management system.

1.3 DEFINITIONS

- A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- B. BICSI: Building Industry Consulting Service International.
- C. EMI: Electromagnetic interference.
- D. LAN: Local area network.
- E. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
- F. RCDD: Registered Communications Distribution Designer.
- G. UTP: Unshielded twisted pair.

1.4 HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications termination room. This cabling and its connecting hardware are called a "permanent link," a term that is used in the testing protocols.
 1. TIA/EIA-568-C.1 requires that a minimum of three telecommunications outlet/connectors be installed for each faceplate indicated.

2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
 3. Bridged taps and splices shall not be installed in the horizontal cabling.
- B. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet in the horizontal cross-connect.

1.5 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-C.1, when tested according to test procedures of this standard.

1.6 SUBMITTALS

- A. Product Data: For each type of product indicated.

1. For all cable, include the following installation data for each type used:

- a. Nominal OD.
- b. Minimum bending radius.
- c. Maximum pulling tension.

- B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. Cabling administration drawings and printouts.
3. Wiring diagrams to show typical wiring schematics, including the following:
 - a. Cross-connects.
 - b. Patch panels.
 - c. Patch cords.
4. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

- C. Qualification Data: For all qualified layout technicians, installation supervisors, and field inspector.

- D. Source quality-control reports.

- E. Field quality-control reports.

- F. Maintenance Data: For splices and connectors to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field testing program development by an RCDD.
 2. Installation Supervision: Installation shall be under the direct supervision of a Registered Technician (BICSI), who shall be present at all times when Work of this Section is performed at Project site.
 3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- B. Testing Agency Qualifications: An NRTL.
1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-B.
- E. Grounding: Comply with ANSI-J-STD-607-A.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Test cables upon receipt at Project site.
1. Test each pair of UTP cable for open and short circuits.
- 1.9 PROJECT CONDITIONS
- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- 1.10 COORDINATION
- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.
- B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-B.
- B. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

1. Support brackets with cable tie slots for fastening cable ties to brackets.
2. Lacing bars, spools, J-hooks, and D-rings.
3. Straps and other devices.

C. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Minimum size of conduit shall be 1 inch.

1. Wall outlet boxes shall be 2 gang, deep, with single gang trim ring.

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements in Division 06 Section "Rough Carpentry" for plywood backing panels.

2.3 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Belden CDT Inc.; Electronics Division.
2. Berk-Tek; a Nexans company.
3. CommScope, Inc.
4. General Cable
5. Hitachi
6. Mohawk; a division of Belden CDT.
7. Superior Essex Inc.
8. SYSTIMAX Solutions; a CommScope, Inc. brand.
9. Siemon Co.

B. Description: 100-ohm, 4-pair UTP, CAT6 (Both Data and Voice). Use Comm Scope Giga SPEED X10D F/UTP CAT .

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-C.1 for performance specifications.
3. Comply with TIA/EIA-568-C.2, Category 6
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
 - a. Communications, Plenum Rated: Type CMP, complying with NFPA 262.

C. Cable Colors

1. Unclassified: Green.
2. Classified: Red.
3. Telephone Blue.

2.4 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Belden/Nordex CDT Inc.; Electronics Division.
 2. CommScope/ Uniprise/ Systemax
 3. Amp NetConnect, a division of Tyco
 4. ADC
 5. Panduit
 6. Leviton.
 7. Siemon Co.
- B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-C.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- C. Patch Panel (Data): Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables. Provide 48 port panel.
1. Number of Jacks per Field: One for each four-pair UTP cable indicated.
- D. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.
- E. Punch Down Blocks (Voice Termination Only): Shall be 66 style to OSP and House cables shall be terminated on rack mounted network patch panels sufficient in size to accommodate number of pair to be terminated, insulation displacement contact (IDC) type hardware. The blocks shall be wall mounted as indicated.
- F. Not Used.
- G. Patch Cords: Factory-made, four-pair cables terminated with eight-position modular plug at each end. Provide two cords for each field cable that is terminated to the patch panels – 1 cord @ 2 meters, and 1 cord @ 3 meters.
1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.

2.5 TELECOMMUNICATIONS OUTLET/CONNECTORS

- A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-C.1.
- B. Workstation Outlets: Provide with the number of ports as noted – 2 ports - connector assemblies mounted in single faceplate.
1. Plastic Faceplate: High-impact plastic. Coordinate color with Division 26 Section "Wiring Devices."
 2. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.
 - a. Flush mounting jacks, positioning the cord at a 45-degree angle.
 3. Legend: Machine printed, in the field, using adhesive-tape label or snap-in, clear-label covers and machine-printed paper inserts.

2.6 GROUNDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
- B. Comply with ANSI-J-STD-607-A.

2.7 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

2.8 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency or staff certified RCDD to evaluate cables.
- B. Factory test UTP cables on reels according to TIA/EIA-568-C.1.
- C. Factory test UTP cables according to TIA/EIA-568-C.2.
- D. Cable will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within cabinets. Conceal raceway and cables except in unfinished spaces.
 - 1. Install plenum cable in all spaces.
 - 2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF PATHWAYS

- A. Comply with requirements for demarcation point, pathways, cabinets, and racks. Drawings indicate general arrangement of pathways and fittings.
- B. Comply with TIA/EIA-569-B for pull-box sizing and length of conduit and number of bends between pull points.
- C. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- D. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- E. Pathway Installation in Termination Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
 - 2. Install basket cable trays to route cables if conduits cannot be located in these positions.
 - 3. Secure conduits to backboard when entering room from overhead.
 - 4. Extend conduits 3 inches above finished floor.
 - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- F. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.4 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 - 1. Comply with TIA/EIA-568-C.1.
 - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 - 3. Terminate all conductors; no cable shall contain un-terminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 - 4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches, not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 - 6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
 - 7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 - 8. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.
 - 9. In the termination room (LAN), install a 6-foot long service loop on each end of cable.
 - 10. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-C.2.
2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.

D. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 36 inches apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. Group connecting hardware for cables into separate logical fields.

F. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-B for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.5 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping."
- B. Comply with TIA/EIA-569-B, "Firestopping."

- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.7 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
 - 1. Administration Class: 2.
 - 2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.
- B. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.
- C. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- D. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration.
- E. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications rooms, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.
- G. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 3. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.
 4. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
- H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.
1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 1. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-C.1.
 2. Visually confirm Category 6 marking of outlets, cover plates, outlet/connectors, and patch panels.
 3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
5. UTP Performance Tests:
 - a. Test for each outlet. Perform the following tests according to TIA/EIA-568-C.1 and TIA/EIA-568-C.2:

- 1) Wire map.
 - 2) Length (physical vs. electrical, and length requirements).
 - 3) Insertion loss.
 - 4) Near-end crosstalk (NEXT) loss.
 - 5) Power sum near-end crosstalk (PSNEXT) loss.
 - 6) Equal-level far-end crosstalk (ELFEXT).
 - 7) Power sum equal-level far-end crosstalk (PSELFEXT).
 - 8) Return loss.
 - 9) Propagation delay.
 - 10) Delay skew.
6. Final Verification Tests: Perform verification tests for UTP systems after the complete communications cabling and workstation outlet/connectors are installed.
- a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
 - b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.
- D. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.
- 3.9 DEMONSTRATION
- A. Engage a factory-authorized service representative to train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets. Include training in cabling administration software.

END OF SECTION

SECTION 281316

SECURITY AND DATABASE MANAGEMENT SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including:
 - 1. General and Supplementary Conditions
 - 2. Division 01 Specification Sections

1.2 SUMMARY

- A. Section includes S2 Security Corporation NetBox®/NetBoxVR®/Enterprise® Security and Database Management System (SMS) consisting of computer hardware, software, and associated licensing and equipment for monitoring, recording, and managing Electronic Access Control System (EACS) and Integrated Systems (IS) data and functionality.
- B. The S2 NetBox®/NetBoxVR®/Enterprise® Security Management System shall meet the requirements of business and government access control systems. The system shall monitor and control facility access, and shall perform alarm monitoring, camera and video monitoring (when integrated with a compatible integrated Video Monitoring System), communications loss monitoring, and temperature monitoring. The system shall also maintain a database of system activity, personnel access control information, and system user passwords and user role permissions. The system shall be controlled from a web browser and require no software installation or client licenses. The system shall provide control and access to users on Local Area Networks (LAN), Wide Area Networks (WAN), wireless networks, and the Internet. The system shall provide email and/or text message alerts for all alarm conditions and threats.
- C. The SMS includes the following sub-components:
 - 1. Operating Systems (OS) software and firmware
 - 2. Application Software
 - 3. Database Software
 - 4. Network connected Server and Client computer hardware
 - 5. Network connected field level controllers

1.3 DEFINITIONS

- A. API: Application Programming Interface
- B. AVI: Audio Video Interleave

- C. CA: Certificate Authority
- D. CAC: Common Access Card
- E. CE: European Union Conformity
- F. CPU: Central Processing Unit
- G. CSV: Comma Separated Values
- H. DNS: Domain Name Server
- I. DSM: Door Status Monitor
- J. DVR: Digital Video Recorder
- K. EACS: Electronic Access Control System
- L. EPS: Events Per Second
- M. FCC: Federal Communications Commission
- N. FIPS: Federal Information Processing Standard
- O. FIFO: First In – First Out
- P. FTP: File Transfer Protocol
- Q. FRAC: First Responder Authentication Credential
- R. GB: Gigabyte
- S. GSOC: Global Security Operations Center
- T. HA: High Availability
- U. HTML: Hypertext Markup Language
- V. H.264: Video Compression Standard
- W. I²C: Inter-Integrated Circuit
- X. IEEE: Institute of Electrical and Electronics Engineers
- Y. I/O: Input/Output
- Z. IP: Internet protocol
- AA. IS: Integrated System
- BB. JPEG: Joint Photographic Experts Group
- CC. LAN: Local area network
- DD. LDAP: Lightweight Directory Access Protocol

EE. MB: Megabyte

FF. MJPEG: Motion JPEG

GG. MSATA: Mini-Serial Advanced Technology Attachment

HH. MSO: Mobile Security Officer

II. MTBF: Mean-Time Between Failure

JJ. NAS: Network Attached Storage

KK. NBAPI: NetBox Application Programming Interface

LL. NECA: National Electric Code Association

MM. NFPA: National Fire Protection Association

NN. NVR: Network Video Recorder

OO. ODBC: Open Database Connectivity

PP. OS: Operating System

QQ. OVID: Open Video Integration Driver

RR. PDF: Portable Document Format

SS. PIN: Personal Identification Number

TT. PIV: Personal Identity Verification

UU. PoE: Power over Ethernet

VV. PTZ: Pan-tilt-zoom

WW. RAID: Redundant Array of Inexpensive Disks

XX. RAM: Random Access Memory

YY. REX: Request to Exit

ZZ. RFID: Radio Frequency Identification

AAA. RoHS: Restriction of Hazardous Substances

BBB. ROM: Read Only Memory

CCC. RU: Rack Unit

DDD. SFTP: Secure File Transfer Protocol

EEE. SHA: Secure Hash Algorithm

FFF. SIO: Serial Input/Output

GGG. SLA: Sealed Lead-Acid

HHH. SMS: Security Management System or Short Message Service (text messaging)

III. SSL: Secure Sockets Layer

JJJ. SUSP: Software Upgrade and Support Plan

KKK. TCP: Transmission control protocol - connects hosts on the Internet

LLL. TIA: Telecommunications Industry Association

MMM.TWIC: Transportation Worker Identification Credential

NNN. UI: User Interface

OOO. UPS: Uninterruptible power supply

PPP. UTP: Unshielded Twisted Pair

QQQ. VMS: Video Management System

RRR. WAN: Wide area network

SSS. Wi-Fi: Wireless Network

1.4 PERFORMANCE REQUIREMENTS

A. The NetBox®/NetBox®VR/Enterprise® SMS shall be certified by to meet the following standards:

1. UL294 Listed
2. ISO 9000 Listed
3. CE
4. FCC Part 15
5. RoHS

1.5 ACTION SUBMITTALS

A. Product Data: Provide details and technical specifications for each product indicated. Include physical dimensions, features, performance, electrical characteristics, ratings, software versions, and operating system details.

B. Shop Drawings: Include system line diagrams, equipment locations, installation details, and system integration plans.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Functional Block Diagram: Show single-line interconnections between components for signal transmission and control. Show cable types, quantities, and sizes.
 3. Plans and Elevations: Dimensioned plans and elevations of equipment racks, enclosures, and conduit interconnections, including access and workspace requirements.
 4. Data Calculations: Provide data bandwidth and storage calculations, including data backup and archive configuration details meeting the minimum project requirements as described herein.
 5. Power and Heat Load Calculations: Provide power and heat load calculations for all hardware, including UPS capacity calculations.
 6. Wiring Diagrams: For power and signal wiring.
- C. Equipment and Software List: Include every piece of equipment and software by product/model name and/or number, manufacturer, serial number, revision number, location, and date of original installation. If factory and/or bench testing regimens are required by the project plan, add pretesting record of each piece of equipment and software, listing name of person testing, date of test, and adjustments made.

1.6 INFORMATIONAL SUBMITTALS

- A. UL and ISO9000 Listing Certificates: For SMS components, from manufacturer.
- B. Field quality-control reports.
- C. Warranty: Sample of product warranty for each system component.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For all SMS components and software to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 1. Lists of spare parts and replacement components recommended to be stored at the site for ready access.
 2. Operating system, database and application software, including installation, and system configuration backup and recovery data on CD or DVD media.

1.8 QUALITY ASSURANCE

- A. All work, equipment, materials, construction, and installation provided under the Contract shall comply with the current applicable rules, regulations, standards, and ordinances of the local Authorities Having Jurisdiction (AHJ).
- B. Electrical Components, Devices, Accessories, and Installation shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 1. Comply with NECA 1.

2. Comply with NFPA 70.
 3. Comply with NFPA 101.
- C. Software integration between the SMS, VMS, and all other integrated system components shall be tested and certified for interoperability by the manufacturers of each system.

1.9 PROJECT CONDITIONS

- A. Environmental Conditions: SMS components shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
1. S2 NetBox Solid State Network Controller:
 - a. Operation: Rated for continuous operation in ambient temperatures of 32 to 95 deg F (0 to 35 deg C) and a relative humidity of 5 to 90 percent, noncondensing.
 - b. Storage: Component storage at ambient temperatures of -4 to 120 deg F (-20 to 49 deg C) and relative humidity of 5 to 90 percent, non-condensing.
 2. S2 NetBox Extreme Network Controller:
 - a. Operation: Rated for continuous operation in ambient temperatures of 32 to 95 deg F (0 to 35 deg C) and a relative humidity of 5 to 90 percent, noncondensing.
 - b. Storage: Component storage at ambient temperatures of -4 to 120 deg F (-20 to 49 deg C) and relative humidity of 5 to 90 percent, non-condensing.
 3. S2 Exacta50 Controller:
 - a. Operation: Rated for continuous operation in ambient temperatures of 50 to 95 deg F (10 to 35 deg C) and a relative humidity of 5 to 90 percent, noncondensing.
 - b. Storage: Component storage at ambient temperatures of -40 to 158 deg F (-40 to 70 deg C) and relative humidity of 5 to 90 percent, non-condensing.
 4. S2 Exacta100 Network Controller:
 - a. Operation: Rated for continuous operation in ambient temperatures of 50 to 95 deg F (10 to 35 deg C) and a relative humidity of 5 to 90 percent, noncondensing.
 - b. Storage: Component storage at ambient temperatures of -40 to 158 deg F (-40 to 70 deg C) and relative humidity of 5 to 90 percent, non-condensing.

1.10 WARRANTY

- A. All SMS systems and components shall be provided with an explicit manufacturer warranty of one year for software and two years for hardware.

PART 2 - PRODUCTS

2.1 OPERATIONAL REQUIREMENTS

- A. The S2 NetBox®/NetBox®VR/Enterprise® Security Management System shall be implemented through network appliance architecture with a three-tiered modular hardware hierarchy and embedded three-tier software architecture.
1. The network appliance shall be capable of running on an existing TCP/IP network and shall be accessible, configurable, and manageable from any network-connected PC with a browser.
 2. Browser access for configuration and administration of the system shall be possible from a PC on the same subnet, through routers and gateways from other subnets, and from the Internet. Control and management of the system shall therefore be geographically independent.
 3. Security of the data communicated over the network to and from the browser, Network Controller, and nodes shall be protected by encryption (SSL 128-bit) or authentication (SHA-1).
 4. The top hardware tier shall be the Network Controller. Embedded on the Network Controller shall be an operating system, a web server, security application software, and the database of personnel and system activity. Converged Video Access systems shall also include fully functional network video recorder.
 5. The middle hardware tier shall be the Network Node. The Network Node shall make and manage access control decisions with data provided by the Network Controller, and it shall manage the communication between the Network Controller and Application blades connected to the system's inputs, outputs, and readers. This modular design shall make it possible, even during network downtime, for the system to continue to manage access control and store system activity logs. When network connectivity is re-established, the system activity logs shall be automatically re-integrated.
 6. The bottom hardware tier shall be the Application Blades. Four unique Application blades shall be available:
 - a. Access Control Blade: shall support two readers, four supervised inputs, and four relay outputs.
 - b. Alarm Input Blade: shall support eight supervised inputs.
 - c. Relay Output Blade: shall support eight relay outputs.
 - d. Temperature Blade: shall support eight analog temperature sensor inputs.
- B. The S2 SMS shall integrate, within a browser interface, access control, alarm monitoring, video monitoring, and temperature monitoring applications. These applications shall be embedded in a three-tier software architecture.
1. The database tier shall use PostgreSQL. PostgreSQL is a full featured, high performance database management system that supports ODBC. This shall provide a small footprint, low administration, and a high reliability relational database that is embedded without requiring the use of a separate PC server.

2. The web server tier shall be based on an Apache™ embedded web server. This shall provide a graphically rich security management application through a standard web browser.
 3. The security application software tier contains the business logic. This application shall also be embedded on the controller and requires no additional memory or processing power.
 4. This three tiered embedded software design runs within an embedded Linux Ubuntu operating system and shall require no client-side software other than a web browser.
- C. All equipment and materials used shall be standard components, regularly manufactured, and regularly utilized in the manufacturer's system.
- D. All S2 systems and components shall have been thoroughly tested and proven in actual use.

2.2 FUNCTIONAL REQUIREMENTS

- A. The system shall support S2's Global product offering. Global is a global security operations center (GSOC) application enabling system operators and administrators to monitor and control multiple distributed S2 NetBox installations simultaneously.
- B. The system shall support S2's Exacta high availability (HA) option. The Exacta HA solution includes two HA servers running Stratus Avance software. They act as a platform for the S2 software and operating system as a virtual machine on one server, which is continually backed up on another.
- C. Widget Desktop: The S2 SMS shall provide a widget-based user interface that enables users to create custom monitoring layouts by selecting and arranging widgets on a desktop.
1. Each widget shall provide easy access to a frequently used function—allowing users to, for example, view an activity log, a camera view, or real-time web content.
 2. System administrators can save custom layouts for subsequent call up by users, who can then arrange the widgets as desired on their desktops. The administrator shall determine which widgets are available in a layout and the extent to which users can customize the layout. Setup privileges shall enable administrators to switch from "Compose Mode" to "Monitoring Mode" from the desktop menu.
 3. When composing layouts, system administrators shall have the ability to display a grid overlay on the Widget Desktop background. Whenever a widget is moved or resized, it will align with (or "snap to") the nearest intersection of lines in the grid. If the grid is saved with the layout, it will appear in the background when users view the layout.
 4. The widgets that shall be available for layouts are: Activity Log, Auto-Monitor, Camera View, Clock, Duty Log Entry, Events, Explorer, Floorplans, Intrusion Panel, Passback Grace, PhotoID History, Portal Status, Portal Unlock, Statistics Block, Status, and Threat Level.
 5. An Alarm Workflow widget shall be available for layouts. This widget shall allow operators to monitor and resolve alarms within the alarm workflow implemented for the system.

6. When composing layouts, it shall be possible to display vertical and horizontal red lines in the background to assure that positioning widgets within these lines will fit the screen of an iPad or MacBook Air.
- D. System Partitioning: The system administrator shall have the ability to divide the S2 SMS into partitions, allowing subsets of the overall population and/or resources to be managed separately.
1. From the default Master partition, one or more additional partitions can be created.
 2. Each partition shall contain some number of administrators, card holders with their credentials, and resources.
 3. When performing administrative functions, the administrator of a partition shall have the ability to affect only the cardholders and resources in that partition. However, resources can be shared across partitions through the mapping of access levels from one partition to another.
 4. System partitioning shall have a precision feature that allows administrators in one or more partitions to view and perform edit functions on person records that belong to another partition.
 5. Administrators shall have the ability to search for person records across all partitions to which they have access. The system administrator shall have the ability to make such cross-partition searches the default for users who have access to multiple partitions.
 6. After finding a person record located in another partition, an administrator shall be able to click a button to switch to that partition directly from the person record—and possibly edit the record, depending on his or her access rights in that partition. Alternatively, provide the option for making every person record seamlessly visible across all partitions.
- E. The S2 SMS shall provide the following Access Control capabilities:
1. Login throttling, which can be enabled for the system to limit the number of login attempts from the same IP address in a given period of time.
 2. Integrated photo ID creation capability with video verification.
 3. User interface secured access under encrypted password control.
 4. System-wide timed anti-passback function.
 5. Regional anti-passback with mustering and roll call functions.
 6. Region occupancy counting and control.
 7. “First-in-unlock” rule enforcement.
 8. Multiple access levels and cards per person.
 9. 128-bit card support for Wiegand card readers.
 10. Detailed time specifications.
 11. Simultaneous support for multiple card data formats.

12. Elevator control.
13. Access privileges variable by threat level.
14. Scheduled portal unlock by time and threat level.
15. Card format decoder quickly discovers unknown card formats.
16. Card enrollment by reader or keyboard.
17. Compatibility with various input devices, including biometric readers.
18. Activation/expiration date/time by person with one minute resolution.
19. Access level disable for immediate lockdown.
20. Use of Threat Levels to alter security system behavior globally.
21. Duress PINs, which can be enabled for the system to allow a valid user to raise an alarm if compelled under duress to use his or her credentials (card and PIN) to allow access for another person.
22. Multiple holiday schedules.
23. Timed unlock schedules.
24. Scheduled actions for arming inputs, activating outputs, and locking and unlocking portals.
25. Optional two-man access restriction for portals, requiring two valid card reads from two separate cardholders for portal entry.
26. Card enrollment reader support.
27. Dual-reader portal support.
28. Wiegand Reader support.
29. Magnetic-stripe reader support with cards using ABA Track 2 format for up to 200 bits.
30. Wiegand keypad PIN support for 4-digit or 6-digit PINs.
31. 8-bit and 4-bit burst keypad support for 4-digit or 6-digit PINs.
32. Integration with supported alarm panels.
33. Support for up to 200 DMP intrusion panels with high-level TCP/IP integration.
34. Optional storage and recall of ID photos and personal/emergency data.
35. Unlimited person records.
36. Up to 20,000 credentials are stored locally. An unlimited number of credentials may be authenticated with the controller, caching the most frequently used credentials on the node.

37. Unlimited number of scheduled actions, with the controller downloading up to of 16 per node per day of the soonest-to-activate actions applying to that node, with any others that remain in the database as candidates for downloading later. Expired scheduled actions are removed automatically.
38. The system shall support tracing a person's activity in the current partition if the "Trace this person" check box is selected on the person record.
39. Search for person records using a credential scan.

F. The S2 SMS shall provide the following Monitoring capabilities:

1. The Home page, which is available from the Monitor: Live Monitoring menu on NetBox and NetBox Extreme, lets users view a full system summary, including the Activity Log, Auto-Monitor, and links to frequent User Tasks.
2. Common alarm panel integration for disarm on access, and arm on egress.
3. Support for the direct viewing of IP cameras.
4. Integrated real-time IP-based NVR systems with stored video replay for events.
5. Provides alarms on video loss, video motion detection, and video restore events.
6. Virtual inputs for video fail, camera normal, video motion, and building occupancy limits exceeded.
7. Provides alarms on communication loss and temperature variation.
8. Support for the creation of custom sets of alarm event actions.
9. Provides the ability to record video and link to video for alarm events.
10. Available video control and playback through the S2 SMS user interface.
11. Provides the ability to assign threat levels to various alarms according to severity.
12. Provides the ability to select up to 20 levels of priority for event actions.
13. Provides the ability to enter a duty log comment into the Activity Log, or to append a unique or preset comment to a particular log entry while viewing the Activity Log.
14. Support for the display of Activity Log entries that include both the time the event occurred on the node and the time it was reported to the controller.
15. Support for electronic supervision of alarm inputs.
16. Support for the use of output relays for enabling circuits under alarm event control.
17. A monitoring desktop that integrates video, system activity logs, floorplans, ID photos, and alarm notifications.
18. Support for the creation of unlimited customized monitoring layouts through the use of widgets, including layouts sized for the iPad or MacBook Air.

19. Graphic floorplans with active icons of security system resources.
20. System user permissions to grant whole or partial access to system resources, commands, and personal data.
21. Secure access to the user interface under encrypted password control.
22. Delivery of alerts via browsers, email, and text messages.
23. Remote Logging of system messages to remote host.

G. The S2 SMS shall provide the following Video Management capabilities:

1. Real-time video monitoring displays, including unlimited cameras simultaneously.
2. Playback of event-related video.
3. Video switching and video widget pop-ups based on access activity or event activation.
4. Integrated alarm inputs from the Video Management System (VMS).
5. Digital playback of video events.
6. Linking of video and events based on triggers provided by the S2 SMS or video system.
7. Support for multiple DVR and NVR systems.
 - a. Up to 4 subordinate NetVR@s and up to 32 cameras with a NetBox@ system
 - b. Up to 3 subordinate NetVR@s and up to 32 cameras with a NetBoxVR@ system, which includes one primary NetVR@ integrated in a NetBoxVR@ unit.
 - c. Up to 8 subordinate NetVR@s and up to 128 cameras with a NetBox Extreme@ system
 - d. Up to 64 subordinate NetVR@s and up to 1024 cameras with an Enterprise Exacta 50@ system
 - e. Unlimited subordinate NetVR@s and cameras with an Enterprise Exacta 100@ system
8. Multiple pre-programmed supported cameras.
9. Recall of photo ID and real-time image for comparison.
10. Monitoring and control through a web browser interface.
11. System user permissions to grant whole or partial access to system cameras and video resources.

H. The S2 SMS shall provide the following Security Database capabilities:

1. Maintain data of system activity, personnel access control information, system user passwords and custom user role permissions for whole or partial access to system resources and data.

2. Partitions: It shall be possible to partition the system to create independent, virtual security management systems for multiple populations.
3. Support for the sharing of access levels and user privileges across partitions in a system.
4. Built-in Open Database Connectivity (ODBC) compliant database for personal data.
5. LDAP or SLDAP integration for single-user logon authentication.
6. Unlimited person records.
7. Network-secure API for external application integration.
8. Extensive and easy to use custom report generator.
9. User-defined data fields in personnel records.
10. Record recall by vehicle tag, name, or card.
11. ODBC compliant Database.
12. An API for adding to, deleting from, and modifying the database.
13. Storage of system user passwords and permissions.
14. Storage and recall of ID photos and emergency personal information.
15. Pre-defined reports on system configuration, system activity history, and people.
16. A Used By feature for listing all correlations between specific card readers, keypads, inputs, and outputs, against groups, portals, elevators, access levels, and other configured access control features. This feature may be useful for quickly determining I/O associations when editing and/or deleting system I/O points.
17. An Audit Trail report that shows changes made to the security database over a specified period of time.
 - a. For each transaction listed in the report results, information is available on when the transaction occurred, who made the changes, the fields that were modified, and the original and new values.
 - b. Search criteria can be applied to filter the report results, either by the person whose record was changed or by the area of the system configuration that was modified.
18. A Credential Audit report that shows all existing access cards by their current status settings. The report also shows for each card the name of the person to whom it was issued and the card number.
19. A Duty Log report shows duty log comments residing in the current security database, including archives.
 - a. For each duty log comment included in the report results, information is available on when the comment was entered, who entered it, the date and time of the

logged event associated with the comment, the name of the logged event, and the specific comment text.

- b. Search criteria can be applied to filter the report results, either by Operator (the user who entered the duty log comment) or by Event type.
20. English-based query language for instant custom reports.
21. Custom report writer interface that allows the interactive creation of custom reports. Reports may be saved for later reuse. No third party software (such as Crystal Reports) shall be necessary.
22. Custom report scheduling and email distribution.
23. Selectable custom report output formats, including PDF, CSV, and HTML (default).
24. Custom report repository location. Users shall be able to review, cancel and delete reports from this data storage location.
25. Seamless search capability for access history reports. The reporting function shall search the database and archive simultaneously for matching report parameters.
26. Column sorting. Reports output shall be user configurable to sort individual columns in both ascending and descending order.
27. Periodic backup to on-board flash ROM and optional Network Attached Storage (NAS), including FTP and SFTP servers.
28. Periodic archive creation for historical custom reporting and improved on-board database performance.
29. Email and text messaging (SMS) alert notifications.

2.3 HARDWARE REQUIREMENTS

- A. The S2 NetBox[®]/NetBox[®]VR/Enterprise[®] SMS shall employ a modular hardware concept that enables simple system expansion and utilizes a three-tiered hardware hierarchy:
 1. At the top tier is the Network Controller, which shall contain the database engine, web server, application software, and configuration data. It is at this level that System Users, through a browser interface, shall interact with the S2 SMS, set configurations, monitor activities, run reports, and manage alarms.
 2. At the second tier is the Network Node, an intelligent device with native TCP/IP support, which shall make and manage access control decisions.
 3. At the third tier are the application extension blades. Each of these blades shall connect to and manage a set of inputs, outputs, readers, cameras or temperature monitoring points.
 4. The network device shall run on existing building TCP/IP networks and shall be configurable for access from separate subnets, through gateways and routers and from the Internet.

5. A MicroNode shall also be available that combines an Access Control blade and a Network Node.
- B. The Network Controller shall contain the operating system, database engine, web server, application software, and configuration data. The Network Controller shall be available in four configurations to support small to medium, large, and ultra-large systems. Those systems shall be identified as: a solid-state NetBox Network Controller, a solid-state NetBox Extreme Network Controller, an Exacta50 Network Controller and an Exacta100 Network Controller.
- C. A solid-state NetBox® Network Controller shall contain a processor, flash memory, and a network switch. The Network Controller shall be supplied with 12V DC at a minimum of 5 amps. Internal battery backup shall supply sufficient power to provide for an orderly shutdown of the system in case of loss of external power. External battery backup shall be used to provide uninterrupted operation in the event of external power loss. The Network Controller is accompanied by a Network Node. The Network Node shall contain I²C for communication with the Application blades and a network interface port. A solid-state Network Controller shall have the following capabilities:

1. Nodes/MicroNodes:	32
2. Access control portals:	32
3. Access cards:	60,000
4. Card formats:	32
5. Alarm input points:	500
6. Control point outputs:	500
7. Temperature monitor points:	500
8. Elevators	20
9. Floors	100
10. Online event history log:	up to 10 million records
11. Ethernet ports:	1
12. Time specifications	512
13. Time spec groups	64
14. Time specs per group	8
15. Threat Levels	8
16. Threat Level Groups	32
17. Holidays	30
18. Access levels per person	32
19. Cards per person	100

20.	Report Groups	50
21.	Camera Groups	50
22.	Concurrent system users	5
23.	Capacity Rating	5 EPS

D. The S2 NetBox® Extreme Network Controller shall be available in wall-mount or 2RU rack-mount enclosure. It shall contain a motherboard with an Intel® Atom™ processor and solid-state disk drive. An Ethernet connector shall be provided for network connection. The NetBox Extreme Network Controller shall have the following capabilities:

1.	Nodes/MicroNodes	64
2.	Access control portals	256
3.	Access cards	150,000
4.	Concurrent system users	10
5.	Alarm input points	2000
6.	Control point outputs	2000
7.	Temperature monitor points:	500
8.	Online event history log:	up to 40 Million records
9.	Ethernet ports:	1
10.	Time specifications	512 per partition
11.	Time spec groups	64 per partition
12.	Time specs per group	8 per partition
13.	Threat Levels	8 per partition
14.	Threat Level Groups	32 per partition
15.	Holidays	30 per partition
16.	Access levels per person	32 per partition
17.	Cards per person	100
18.	Report Groups	50
19.	Camera Groups	50
20.	Capacity Rating	10 EPS

E. The S2 Exacta50 Network Controller shall consist of a 1RU rack-mounted Controller with additional processing power, memory and solid state disk drive. The Exacta50 Network Controller shall have the following capabilities:

1. Nodes/MicroNodes 128
2. Access control portals 1792
3. Access cards unlimited
4. Concurrent system users 25
5. Alarm input points 2000
6. Control point outputs 2000
7. Temperature monitor points: 500
8. Online event history log: up to 160,000,000 records
9. Ethernet ports: 1
10. Time specifications 512 per partition
11. Time spec groups 64 per partition
12. Time specs 8 per group
13. Threat Levels 8 per partition
14. Threat Level Groups 32 per partition
15. Holidays 30 per partition
16. Access Levels per person 32 per partition
17. Credentials per person 100
18. Report Groups 50
19. Camera Groups 50
20. Capacity Rating 30 EPS

F. The S2 Exacta100 Network Controller shall consist of a 1RU rack-mounted controller with additional processing power and memory, RAID-1 solid state disk drive array, serial port and network connections. The Exacta100 Network Controller shall have the following capabilities:

1. Nodes/MicroNodes 512
2. Access control portals 7168
3. Access cards unlimited
4. Concurrent system users 35

5.	Alarm input points	2000
6.	Control point outputs	2000
7.	Temperature monitor points:	500
8.	Online event history log:	up to 400,000,000 records
9.	Ethernet switch ports:	1
10.	Time specifications	512 per partition
11.	Time spec groups	64 per partition
12.	Time specs	8 per group
13.	Threat Levels	8 per partition
14.	Threat Level Groups	32 per partition
15.	Holidays	30 per partition
16.	Access Levels per person	32 per partition
17.	Credentials per person	100
18.	Report Groups	50
19.	Camera Groups	50
20.	Capacity Rating	96 EPS

G. The Network Node shall make and manage access control decisions with data provided by the Network Controller, and it shall manage the communication between the Controller and Application blades connected to the system's inputs, outputs, and readers. The Node shall be supplied with 120V AC at a minimum of 5 amps. Each Network Node shall support up to seven Application blades except for MicroNodes. Communications between the node and Network Controller shall be encrypted and authenticated (SHA-1). Each Network Node shall have the following capabilities:

1.	Application blades	7
2.	Access control readers	14
3.	Access Levels	512
4.	Portals	14
5.	Portal Groups	64
6.	Readers	14
7.	Reader Groups	128
8.	Supervised Inputs	56

9.	Input Groups	64
10.	Relay Outputs	56
11.	Output Groups	64
12.	Temperature Monitor Inputs	56
13.	Elevators	14
14.	Floors	52
15.	Floor Groups	128
16.	Credential storage	20,000
17.	Activity Log records	27,000

H. The Application blades shall interface with the Network Controller through the Network Node. The Application blades shall be blade-style circuit cards. There shall be four types of Application blades:

1. Access Control blade: shall support 2 readers (input devices such as keypads, RFID devices or Biometric readers), 4 supervised inputs and 4 relay outputs.
2. Supervised Input blade: shall support 8 supervised inputs. Supervised input connectors are 2-pin. The system shall support a wide variety of input supervision types such as: no-resistor, one resistor or two resistor including normally-open circuit and normally-closed circuits.
3. Relay Output blade: shall support 8 relay outputs. Outputs are form C relay represented by 3-pin connectors. Both normally-open circuit and normally-closed circuit output devices are supported. The relay outputs shall support any output devices that operate on the following maximum electrical ratings: 30 Volts DC or AC, 2.5 Amps inductive or 5.0 Amps non-inductive.
4. Temperature blade: shall support 8 analog temperature sensor inputs. Temperature range shall be 32° to 158° F (0° to 70° C). Temperature precision within that range shall be ±1.0° F (±0.5° C).

I. The MicroNode® shall combine a Network Node and an Application blade capability in one enclosure. The Access Control blade portion of the MicroNode® shall support two readers, one temperature input, four supervised inputs and four relay outputs. A MicroNode® shall utilize 12VDC power at 3 Amps or Power over Ethernet (PoE) at the 802.3AF standard and be capable of supplying direct power to 2 readers, 2 motion REXs, and 2 door strikes.

2.4 HARDWARE ENCLOSURES AND POWER REQUIREMENTS

A. The S2 NetBox®/Enterprise® Security Management System shall have various hardware enclosures and configurations available to support different installation requirements. Enclosures shall be available for wall or rack mounting. The wall-mount enclosures shall have a lock requiring a key, and a cabinet door tamper switch.

- B. The S2 NetBox® Network Controller supports one solid-state Network Controller blade, a Network Node blade, and seven Application blades. The dimensions are: 17" (431.8 mm) H x 17.5" (444.5 mm) W x 8.25" (210 mm) D.
- C. The S2 Network Node Wall-Mount enclosure supports a Network Node blade, and seven Application blades. The dimensions are: 15" (381 mm) H x 17" (431.8 mm) H x 6.75" (171 mm) D.
- D. The S2 Rack-Mount Node enclosure supports a Network Node blade, and seven Application blades. The dimensions are: 19" (483 mm) W x 7" (178 mm) H (4U) x 15" (381 mm) D.
- E. The S2 NetBox Extreme Network Controller wall-mount units shall be housed in an enclosure with dimensions of: 12" (304.8 mm) W x 14" (355.6 mm) H x 3.5" (88.9 mm) D. The rack-mount unit dimensions shall be 2U rack x 12" (304.8 mm) D.
- F. S2 Exacta50 and Exacta100 Network Controllers shall be housed in a 1RU rack-mount enclosure with dimensions of 17.25" (438 mm) W (not including the mounting brackets) x 1.8 " (46 mm) H x 22.4" (569 mm) D.
- G. The S2 MicroNode enclosure shall support a solid-state Node, its Access Control blade, and one temperature point.
 - 1. It shall be a wall-mount enclosure with dimensions of 7.2" (183 mm) H x 7" (178 mm) W x 3.58" (91 mm) D.
 - 2. It shall be possible to power the MicroNode with a 12VDC power source at no less than 3 Amps, or from PoE switch that conforms to the IEEE 802.3af standard, which provides nominal 48VDC at a maximum of 400mA.
- H. The solid-state NetBox Controllers shall be powered by either 100-240V AC at 50-60 Hz, or by 12VDC at 5 amps. Power must come from a separate circuit with an isolated earth ground. If AC power is supplied it must be connected to the internal power supply. If DC power is supplied the internal power supply shall be bypassed. It shall be possible to backup power supplied to the S2 SMS with an Uninterruptible Power Supply (UPS). It shall also be possible to place within the wall-mount enclosure an SLA battery backup sufficient for an orderly shutdown in case of external power loss.
- I. Exacta50 and Exacta100 controllers shall be powered by 100-240V AC at 50-60 Hz. Power must come from a separate circuit with an isolated earth ground and it must be connected to the internal power supply. It shall be possible to backup power supplied to the rack-mounted Exacta50 and Exacta100 controllers with an Uninterruptible Power Supply (UPS).

2.5 S2 NETWORK CONTROLLER, NODE, AND APPLICATION BLADE HARDWARE SPECIFICATIONS

- A. S2 Solid-state Network Controller - All Application blades shall receive 12VDC power via the ribbon cable bus directly from the Node. The solid-state NetBox Controllers shall be powered by either 100-240V AC at 50-60 Hz, or by 12VDC at 5 amps.
 - 1. OS Ubuntu 10.04 LTS
 - 2. Storage 20GB MSATA(minimum)
 - 3. Processor Intel N2800 1.86GHz 2 Cores 4 Threads

4.	RAM	2 GB
5.	Ethernet Ports	1
6.	Network Nodes Supported	32
7.	Capacity Rating	5 EPS (events per second)
8.	Certifications/Compliances	UL, CE, FCC Part 15, RoHS
9.	Warranty	2 years
10.	Dimensions (H, W, D)	17in x 17.5in x 8.25in
11.	Weight	10 lbs. (4.54 kg) (minimum configuration)
12.	Operation Temperature	0 to 35 degrees C
13.	Storage Temperature	-20 to +70 degrees C
14.	Relative Humidity	5-90% non-condensing
15.	MTBF	105000 hours
16.	AC Input	85-264 VAC 47-440 Hz 1.5A max @ 115VAC
17.	BTU Rating	204 BTU

B. S2 NetBox Extreme Network Controller:

1.	OS	Ubuntu 10.04 LTS
2.	Storage	20GB MSATA(minimum)
3.	Processor	Intel N2800 1.86 GHz 2 Cores 4 Threads
4.	RAM	2 GB
5.	Ethernet Ports	1
6.	Network Nodes Supported	64
7.	Capacity Rating	10 EPS (events per second)
8.	Certifications/Compliances	UL, CE, FCC Part 15, RoHS
9.	Warranty	2 years
10.	Dimensions (H, W, D)	14in x 12in x 3.5in
11.	Weight	7 lbs. (3.18 kg)
12.	Operation Temperature	0 to 35 degrees C
13.	Storage Temperature	-20 to +70 degrees C

- | | | |
|-----|-------------------|--|
| 14. | Relative Humidity | 5-90% non-condensing |
| 15. | MTBF | 105000 hours |
| 16. | AC Input | 85-264 VAC 47-440 Hz 1.5A max @ 115VAC |
| 17. | BTU Rating | 204 BTU |

C. S2 Exacta50 Controller:

- | | | |
|-----|----------------------------|-----------------------------------|
| 1. | OS | Ubuntu 10.04 LTS |
| 2. | Storage | 1 (128GB) SSD'S |
| 3. | Processor | Intel Pentium G850 |
| 4. | RAM | 4 GB |
| 5. | Ethernet Ports | 1 |
| 6. | Network Nodes Supported | 128 |
| 7. | Capacity Rating | 30 EPS (events per second) |
| 8. | Certifications/Compliances | UL, CE, FCC Part 15, RoHS |
| 9. | Warranty | 2 years |
| 10. | Dimensions (H, W, D) | 1.67in x 17.25in x 21.8in |
| 11. | Weight | 18 lbs. (8.16 kg) |
| 12. | Operation Temperature | +10 to +35 degrees C |
| 13. | Storage Temperature | -40 to +70 degrees C |
| 14. | Relative Humidity | 90% non-condensing @ 35 degrees C |
| 15. | MTBF | 172199 hours @ 40 degrees C |
| 16. | AC Input | 90 - 264 VRMS 47/63Hz 6/3 A |
| 17. | BTU Rating | 596 BTU |

D. S2 Exacta100 Network Controller:

- | | | |
|----|-----------|---|
| 1. | OS | Ubuntu 10.04 LTS
(Ubuntu 12.04 LTS for HA deployments) |
| 2. | Storage | 2 (128 GB) SSD's configured RAID-1 |
| 3. | Processor | Intel E3-1220v2 3.1 GHz 4 cores 4 threads |
| 4. | RAM | 8 GB |

5.	Ethernet Ports	1
6.	Network Nodes Supported	512
7.	Capacity Rating	96 EPS (events per second)
8.	Certifications/Compliances	UL, CE, FCC Part 15, RoHS
9.	Warranty	2 years
10.	Dimensions (H, W, D)	1.67in x 17.25in x 21.8in
11.	Weight	19 lbs. (8.62 kg)
12.	Operation Temperature	+10 to +35 degrees C
13.	Storage Temperature	-40 to +70 degrees C
14.	Relative Humidity	90% non-condensing @ 35 degrees C
15.	MTBF	172199 @ 40 degrees C
16.	AC Input	90 - 264 VRMS 47/63Hz 6/3 A
17.	BTU Rating	686 BTU

E. S2 MicroNode - Each MicroNode shall function as a node and as an access control blade. In addition each MicroNode shall support one temperature input. The MicroNode may be supplied with 12VDC at 3 amps. With a 12VDC 3A power supply the total power available for all external output is 1100mA (13 watts). Alternatively, it shall also be possible to power the MicroNode by the PoE source that conforms to the IEEE 802.3af standard which, provides nominal 48 VDC at a maximum of 400mA. With PoE as the power source the total power available for all external 12V output is 500mA (6 watts).

1.	7-pin reader connectors	2
2.	Maximum reader wire length	500 feet (152 m) (18 AWG twisted, shielded)
3.	2-pin supervised input connectors	4
4.	Maximum input wire length	2000 feet (610 m) (22 AWG twisted, shielded)
5.	3-pin relay output connectors	4
6.	Maximum output wire length	Determined by the peripheral device
7.	2-pin analog temperature inputs	1
8.	Maximum temperature wire length	1000 feet (305 m) (18 AWG twisted, shielded)

F. S2 Access Control Blade - The access control blade shall receive power via the ribbon cable bus directly from the Node Blade. The access blade shall supply up to 500 mA of power to one reader or 250 mA of power to each of two readers.

1.	7-pin reader connectors	2
----	-------------------------	---

2. Maximum reader wire length 500 feet (152 m) (18 AWG twisted, shielded)
 3. Power available to readers 500 mA
 4. 2-pin supervised input connectors 4
 5. Maximum input wire length 2000 feet (610 m) (22 AWG twisted, shielded)
 6. 3-pin relay output connectors 4
 7. Maximum output wire length Determined by the peripheral device
- G. S2 Input Blade - The input blade shall receive power via the ribbon cable bus directly from the Node Blade. It shall support a wide variety of input supervision types including normally-open circuit and normally-closed circuits, and zero, one or two resistor configurations.
1. 2-pin supervised input connectors 8
 2. Maximum input wire length 2000 feet (610 m) (22 AWG twisted, shielded)
- H. S2 Output Blade - The output blade shall receive power via the ribbon cable bus directly from the Node Blade. Both normally-open circuit and normally-closed circuit output devices shall be supported. The relay outputs shall support any output devices that operate on the following maximum electrical ratings: 30 Volts DC or AC, 2.5 Amps inductive or 5.0 Amps non-inductive.
1. 3-pin relay output connectors 8
 2. Maximum output wire length 2000 feet (610 m) (22 AWG twisted, shielded)
 3. S2 Temperature blade - The temperature blade shall receive power via the ribbon cable bus directly from the Node Blade.
 4. 2-pin analog temperature inputs 8
 5. Maximum temperature wire length 1000 feet (305 m) (18 AWG twisted, shielded)

2.6 SOFTWARE REQUIREMENTS

- A. Operating System and Application Software:
1. The embedded operating system for the solid-state NetBox®, NetBox Extreme, Exacta50, and Exacta100 Network Controllers is Linux Ubuntu 10.04 LTS (long term support) as the operating platform. The operating system kernel shall be open-source and no operating system training or certification shall be necessary.
 2. The S2 SMS application software shall be embedded in the system. The database shall be an embedded PostgreSQL relational database requiring a small footprint and provides high reliability. The web server shall be based on an embedded Apache™ web server enabling users to access and operate the system using a standard web browser.
 3. The S2 SMS shall support the following web browsers:

- a. For the SMS (NetBox, NetBox Extreme, and Enterprise) products the listed browsers include; Internet Explorer 11, Internet Explorer 9, Firefox 33, Firefox 32, Safari 6, and Safari 5
 - b. For The S2 Global SMS; Internet Explorer 9 is required
 - c. For S2 Security's VMS line (NetBox VR and NetVR); Internet Explorer 9 or Safari 6 are supported.
- B. S2 Software Licensing:
1. Software licensing shall be based upon the number of readers, cameras, and select features for one Network Controller. Software license upgrades shall be available if system reader and camera capacity must be raised. The S2 user license shall be valid in perpetuity and shall include one year of software updates from the date of shipment from the factory.
 2. Licensing shall be controlled by a Product Key and an Activation Key. The Product Key contains the licensed system features and limits. To upgrade your system license to enable more cameras or more doors you will need a new Product Key. The Activation Key contains the warranty expiration date. The keys are locked to the system license number. The system license number shall be viewable on-screen on the Support : About page
- C. Software upgrades shall be possible from a browser on any network-connected PC, by uploading a software update to the Controller. Controllers shall automatically upgrade all connected nodes. No client software installation shall be necessary.
- D. Online Help and Documentation - The S2 SMS shall be provided with complete embedded documentation. The online documentation shall include:
1. Context-sensitive online Help - (The Help displayed is specifically relevant to the current screen.) The online Help system shall provide explanations and procedures for all monitoring, administrative, and system configuration and maintenance functions. The Help system shall have linked table of contents, a linked index, and frequently asked questions pages. Each topic shall also have links to related topics. Each Help topic shall be printable.
 2. Technical Support Notes - These documents shall be in PDF format, shall be printable, and shall be linked to from the Help system table of contents, index, and related topics.
 3. Installation Guides - These documents shall be in PDF format, shall be printable, and shall be linked to from the Help system table of contents, index, and related topics.
 4. Video Integration Guides - These documents shall be in PDF format, shall be printable, and shall be linked to from the Help system table of contents, index, and related topics.
 5. End-User Task Guide - This document shall be in PDF format, shall be printable, and shall be linked to from the Help system table of contents, index, and related topics
- E. S2 Support Collaboration - It shall be possible, by the use of a network Support Collaboration Tool, for a technical support specialist to connect to the S2 SMS and assist on-site technicians from remote network-connected locations. It shall only be possible for an on-site system administrator or technician to initiate this connection. There shall be no way to initiate this connection from outside of the secure network.

- F. Language Support - The S2 SMS shall be provided with multiple language support. The ability to switch from one language to another shall be accomplished through the user interface. Translation of the user interface, online help and documentation into other languages shall be available. The languages supported shall include:
1. English
 2. Spanish
 3. Portuguese
 4. French
 5. Italian
 6. Thai
 7. Chinese Traditional
 8. Chinese Simplified
 9. Japanese
- G. Date Formats - The S2 SMS shall support global date formats as follows:
1. mm/dd/yyyy
 2. dd/mm/yyyy
 3. yyyy/mm/dd
- H. Floor plans - The S2 SMS shall provide graphic floorplan capability including graphic display of links to other floorplans, alarms, system resources such as portals, IP video cameras, inputs, outputs, and temperature monitoring points.
1. The Network Administrator holding at least a "Setup" user role shall be able to graphically configure device icons onto the floorplan images, and to upload additional floorplan images. JPEG images shall be supported, and the maximum size for a floorplan image shall be 256K.
 2. It shall be possible to create floorplan groups for the purpose of assigning or withholding assignment of these groups to system user permissions known as Custom User Roles. If a floorplan group is assigned to a particular system user then the floorplans in that group shall be viewable by that system user.
- I. Personnel Data - The S2 SMS shall maintain person data relating to access control, system user privileges, photo identification, system activity, and contact information.
1. All person data in the system shall be integrated onto one tabbed page for viewing, editing, and deletion by system users.
 2. A system user holding at least an Administrator user role shall be able to create, delete, and modify person records, including access levels.

3. A system user holding at least a “Setup” user role shall be able to configure the display of person records. For example, the user shall be able to hide various tabs, and configure the User-defined tab by changing the tab label and customizing any of the 20 data fields that appear on the tab. The user shall also be able to define UDF value lists, which can be displayed as pre-entered drop-down lists for user-defined data fields.
- J. Data Import and Export - A Data Management Tool shall be provided that supports, via an API, the import and export of personnel data. This tool shall make possible the pre-populating and ongoing populating, of cardholders into the S2 SMS database. Data that shall be importable and exportable shall include:
1. LASTNAME
 2. FIRSTNAME
 3. MIDDLENAME
 4. ACTDATE (activation date)
 5. EXPDATE (expiration date)
 6. NOTES
 7. TEXT1...TEXT20 (user defined fields 1 through 20)
 8. ACCESSLEVEL1...ACCESSLEVEL32
 9. PERSONID
 10. PIN
 11. ENCODEDNUM1...ENCODEDNUM10
 12. HOTSTAMPNUM1...HOTSTAMPNUM10
 13. CARDFORMAT1...CARDFORMAT10
 14. BADGELAYOUT
 15. JPEG ID PHOTO
 16. CONTACT PHONE
 17. CONTACT EMAIL
 18. CONTACT SMS EMAIL
 19. CONTACT LOCATION
 20. OTHER CONTACT NAME
 21. OTHER CONTACT TELEPHONE
 22. OTHER CONTACT TELEPHONE2

23. VEHICLE 1 COLOR
24. VEHICLE 1 MAKE
25. VEHICLE 1 MODEL
26. VEHICLE 1 STATE
27. VEHICLE 1 LICENSE#
28. VEHICLE 1 TAG#
29. VEHICLE 2 COLOR
30. VEHICLE 2 MAKE
31. VEHICLE 2 MODEL
32. VEHICLE 2 STATE
33. VEHICLE 2 LICENSE#
34. VEHICLE 2 TAG#
35. LASTMOD

K. Data Security:

1. Communication between the S2 Network Controller and the browser shall be secured using SSL. In addition, administrative access to the security management application and the personnel data shall be password protected and controlled by roles-based authorizations.
2. Communication between the S2 Network Controller and the S2 Network Nodes shall be encrypted and authentication/tamper detection shall be done using the SHA-1 algorithm.
3. Communication between the S2 Network Controller and other systems (when using the API) shall be secured using SSL and authentication/tamper detection shall be done using the SHA-1 algorithm.

L. Data Backups - It shall be possible to configure regular automatic database backups.

1. It shall be possible to back up a solid-state NetBox Network Controller and NetBox Extreme Network Controller to a built-in solid state hard drive.
2. It shall be possible to back up an Exacta50 and Exacta100 Network Controllers to a built-in solid state hard drive.
3. It shall be possible to save backups from any controller to separate network attached storage (NAS), file transfer protocol (FTP) and SFTP servers
4. It shall also be possible to setup regular automatic creation of database archive files.

M. On-board Data Management - Each night the S2 SMS shall truncate a sufficient number of the oldest records held on-board to reduce the database to its set limit, if required. This shall create

the needed storage space for additional system activity records. Truncation will be performed on a First-in, First-out (FIFO) basis.

- N. Partitions - It shall be possible to create multiple partitions for the management of multiple security systems or multiple populations.
1. It shall be possible to limit access to the data and resources of one partition to those with permissions for that partition.
 2. It shall be possible for each partition to have its own population, resources, rules, events, video management, log data, reports and network resources.
 3. It shall be possible to grant Monitor, Administrator and Setup privileges for multiple partitions to the same user. It shall also be possible to create custom user roles for each partition.
 4. A node can reside in only one partition. It shall be possible to create partitions without nodes.
- O. User Roles and Permissions - There shall be four pre-programmed levels of User Roles, and a total of 16 possible Custom User Roles that can be configured in the system with different permissions for each user:
1. Master Partition Monitor - These users may use the functions in the Monitor menu only within the Master (default) partition. Monitor functions shall include viewing the activity log, cameras, and floorplans.
 2. Master Partition Administrator - These users may use the functions of both the Administration and Monitor menus only within the Master (default) partition. Administrative functions shall include adding and editing person information in the enrollment database, issuing and revoking cards, generating reports, and performing database backups.
 3. Master Partition Setup - These users may use the functions of the Setup, Administration, and Monitor menus only within the Master (default) partition. Setup functions shall include defining access control, alarm event behavior, camera settings, floorplan images and configurations, holiday and time specifications. Setup functions shall also include: designation of network resources such as time and DNS servers, email and network storage settings; performance of system maintenance such as database backup and restore, software updates and file cleanups; designation of time zone, daily backup schedule and enrollment readers.
 4. Full System Setup - These users may use the functions of all menus in all partitions.
 5. Custom User Roles - In addition to the roles above the system shall also support the creation of detailed user permissions regarding which data operations, cameras, floorplans, elevators, events, access levels, portals, reports, and personal data fields the system user may see, edit, delete, or control.
- P. Alarm Panels - The S2 SMS shall be capable of integrating with alarm panels, arming the panels, disarming the panels, and triggering events based upon alarm panel status.
- Q. DMP Intrusion Panels - The S2 SMS shall be capable of integrating with Digital Monitoring Products (DMP) XR500 and XR550 Command Processor Panels.

1. Security administrators can use events on a DMP panel, such as a zone going into an alarm state, to trigger events in the S2 SMS. They can also use events in the S2 SMS to control operations on the DMP panel, such as the arming or disarming of an area.
 2. Monitors can use the Intrusion Panel widget to view configuration and status information for a DMP panel. They can also arm and disarm areas, bypass and reset zones, and activate and deactivate outputs associated with the panel.
 3. The system shall support at least 200 DMP panels.
 4. The DMP panels shall communicate their status to the system using port 6000 (PC Logging)
 5. The system shall assign precedence to arm/disarm commands sent from the UI to the DMP panels.
 6. DMP system messages shall identify the panel that generated the message.
 7. Communication errors between the DMP panels and the S2 SMS shall be re-tried after one minute.
- R. Alarm Events - The S2 SMS shall be capable of managing alarm events.
1. It shall be possible to delay an input's change to the Alarm state by a specified number of seconds. The range of delay options shall be 0.5 seconds or from 1 to 120 seconds.
 2. It shall be possible to associate specific actions with each alarm event. These actions may include, but are not limited to:
 - a. Lock and Unlock portals.
 - b. Activate and Deactivate relay outputs.
 - c. Arm and Disarm input groups.
 - d. Pulse outputs or output groups.
 - e. Arm and Disarm alarm panels.
 - f. Send emails and SMS messages.
 - g. Move cameras to preset positions.
 - h. Switch to a video monitor.
 - i. Record video.
 - j. Momentarily unlock portals.
 - k. Change the threat level for a location, and (optionally) for its sub-locations.
 - l. Make entries in the activity log.
 - m. Play a digital sound file; it shall be possible to specify that it play in a loop until cleared or acknowledged.

- n. Display alarms in different colors.
 - o. Set a priority for an alarm (one of 20 levels, with 1 being the highest).
 - p. Require a duty log entry.
 - q. Clear alarm automatically or require an acknowledgement.
3. A system user holding at least a "Setup" user role shall be able to create, delete, and modify alarm system inputs, input groups, outputs, output groups, alarm panels, and events.
 4. It shall be possible to trigger events based on system activity such as:
 - a. Failed login attempts.
 - b. Video motion detection.
 - c. Camera failure and camera restore events.
 - d. Valid or Invalid card reads.
 - e. Portals held or forced open.
 - f. Valid card reads with a specified access level.
 - g. Inputs entering an alarm state.
 - h. High and low temperature events.
 - i. Alarm panel arming failures.
 - j. Alarm panel zone faults.
 - k. Tailgating and passback violations.
 - l. Occupancy limit event
 - m. Zone empty violations.
 - n. Node power failure, communication failure, timeout, and tamper events.
 5. It shall be possible to clone an event which creates an event with all attributes of the original, needing to change only the event's name and any attributes it will not have in common.

S. Activity Monitoring:

1. The S2 SMS shall support a Monitoring Desktop that integrates video, system activity logs, floorplans, ID photos, and alarm notifications.
2. Activity Log viewing includes one-click navigation to person records.
3. The system shall support a Widget Desktop that allows the creation of custom monitoring layouts. Within a custom layout, widgets display live video, system activity logs, alarm

notifications, ID photos, floorplans, duty log entries, portal status displays, and DMP intrusion panels.

4. The system shall be capable of displaying specific alarm events in the Events and Alarm Workflow widgets in one of the following three modes:
 - a. *Activations do not display alarms* – No alarm events shall be displayed in either widget when such events are configured in this mode. All settings shall be disabled in the Acknowledgements section of the page.
 - b. *Multiple activations display a single alarm* – Alarm events shall appear in both widgets each time the alarm input is triggered. Each subsequent trigger of the same input shall display a new alarm event which shall replace the previous one.
 - c. *Multiple activations display multiple alarms* – Alarm events shall appear in the Events widget as described in item b above. The Alarm Workflow widget shall simultaneously display a separate alarm event for each alarm trigger.
 5. Many widgets support multiple partition viewing and filtering. For example, the Activity Log widget can display data from multiple partitions and data filtered by event type or reader group, and/or based on the text content of the event. Additionally, the system shall support the use of category filters, including Access Control, Alarms and Events, Threat Levels, System Admin, Devices, Network Nodes, Access Granted, and Access Denied.
 6. It shall also be possible to view cameras, activity logs, and floorplans on separate monitoring pages within the application.
 7. The system shall support tracing a person's activity in the current partition if the "Trace this person" check box is selected on the person record. The traced activity is displayed in bold in the color selected for "Trace person log color" on the Network Controller page. In addition, if an event is selected for "Trace person event" on the Network Controller page, it is triggered each time a traced person makes an access attempt. These event activations can be reported using a Trace people filter in a custom history report.
 8. The activity log shall be capable of displaying additional cardholder information, including "Hot Stamp", "Encoded Number", and "Company ID".
 9. The system shall include a Photo Display Widget, which allows operators to display a current ID photo for based on the most recent access request.
- T. Network-based Cameras and Video Surveillance - The system shall provide live IP video surveillance capability. The number of supported cameras shall be limited only by license. The system's video capabilities shall include video monitor switching based on access activity. The system shall provide monitoring, configuration, and administration of IP video. Cameras can be separately monitored or monitored in groups.
1. Presets - The system shall support the creation, deletion, and editing of camera preset positions in the system. It shall also be possible to save changes in preset positions directly to a camera..
 2. Views - The system shall support the creation, deletion, and editing of multiple camera views, specifically Quad views (four cameras), NetVR 2x2 view and NetVR 1+7 views. The application shall provide a drop down pick list for selecting current views or naming of new views.

U. Access Control:

1. The S2 SMS shall be able to make access control decisions, define a variety of access levels and time specifications, write system activity into a log file, maintain a personnel enrollment database, receive signals from input devices such as door switch monitors, card readers and motion detectors, energize devices such as door locks and alarms via outputs.
2. Time Specifications: The system shall be capable of storing up to 512 time specifications. Each time specification must be assigned a unique alphanumeric name of up to 64 characters. The definition of a time specification shall require the assignment of both a start time and an end time. Each day of the week shall be individually assignable for inclusion in time specifications. Up to three holiday groups shall be assignable for inclusion in time specifications. If no holidays are assigned to a time specification then no holiday access shall be allowed.
 - a. Time specifications shall be assignable to access levels, output groups, portal groups, input groups, and alarm events.
 - b. Time specifications shall function appropriately per node for the time zone specified for that node.
3. Card Formats - The system shall support the use of readers that use the Wiegand Reader Interface. The system shall support but not require the use of the card facility code. The system shall also support the use of the Magnetic Stripe ABA track 2 card data formats.
 - a. It shall be possible to create new card formats, designate start bits and bit lengths for facility codes and card ID numbers, as well as designate parity bits. The system shall support up to 32 different card formats. The system shall support card formats up to 128 bits.
 - b. It shall be possible to reverse the read order of the bits in the facility code and/or card ID portions of a card format.
 - c. It shall be possible to view and change the default parity bit definitions for a card format.
 - d. A card formats shall be disabled by default. Once enabled, the format appears in the card format dropdown within the credential section of a person record.
 - e. The system shall support the use of a concatenated version of the FIPS 201 format (Federal Information Processing Standard Publication 201)
 - f. FIPS 201 128-bit format. This system-owned credential format is based on Federal Information Processing Standard (FIPS) 201. It can be enabled and disabled, but it cannot be modified. The credential number is a Federal Agency Smart Credential-Number (FASC-N) containing 32 characters, encoded as binary-coded decimal (BCD) digits. When issuing a credential using this format, a user can either enroll the credential via an enrollment reader or use a dialog box to enter a value for each of the fields that make up the 32 BCD string
 - g. Administrators shall be able to specify a specific number of days of non-use that will be allowed before unused cards will be disabled. Administrators shall be able to exempt individual users from this non-use rule.

8. Keypad Commands - For S2 Node connected access control keypads and combination card reader/keypads, users having the authorized access levels shall be capable of executing keypad initiated commands based on pre-defined two-digit number codes.
 - a. Keypad commands shall be defined by mapping one or more two-digit codes to events defined in the system using the "Setup: Alarms: Keypad Commands" page.
 - b. Keypad commands shall be assigned to specific keypads using the "Setup: Access Control: Readers/Keypads" page.
 - c. Keypad commands shall be assigned to specific access levels using the "Setup: Access Control: Access Levels" page.
9. Holidays - The system shall be capable of storing up to 30 holidays per partition. Each holiday must be assigned a unique alphanumeric name of up to 64 characters. The definition of a holiday shall require a start date and an end date. Holidays shall have the ability to span several days using only one holiday slot. Holiday definitions shall support the designation of a start time and an end time. If no start time is designated then the system shall default to 00:00 (start-of-day). If no end time is designated then the system shall default to 24:00 (end-of-day). Holidays shall require the use of 24-hour time format, e.g. 17:00 is 5:00PM.
10. Portals - A portal is any access point and each portal supports up to two readers. The System User, holding at least a "Setup" user role, shall be able to view current portal definitions, change portal definitions, delete portals, and create new portals. Creating a portal defines the access and alarm behavior of the access point. This can include:
 - a. Card readers and keypads.
 - b. Output for locking.
 - c. Input for monitoring the door switch.
 - d. Input for a Request-to-Exit function.
 - e. Local alarm outputs and system alarm events.
11. Portal Groups - It shall be possible to create groups of portals and to assign an unlock time specification to the entire group. All the portals in the group shall remain unlocked during the time specified.
 - a. It shall be possible to use portal groups for the purpose of assigning or withholding assignment of these groups to system user permissions known as Custom User Roles. If a portal group is assigned to a particular system user then the portals in that group shall be viewable and unlockable by that system user.
12. Portal Alarm Conditions - Portals shall have four alarm conditions. The four alarm conditions are as follows:
 - a. Forced: When a portal is opened and there has been no card read, nor request to exit.
 - b. Held: When a portal is held open past the expiration of the shunt timer.

- c. Invalid: When the portal reader reads a card for which there is no entry in the database.
 - d. Valid: When the portal reader reads a card for which there is a valid entry in the database.
13. Two-man entry restriction: It shall be possible to require two valid card reads by different cardholders within a specified number of seconds for entry to a specific portal.
14. Escort Rule - The system shall be capable of supporting escorted access control rules by assigning one of the following two escort types to each cardholder:
- a. Escort - Cardholders with this access level shall enable access for persons requiring escorted access by presenting their credential at a card reader within 15 seconds after those requiring escorted access.
 - b. Requires Escort - Cardholders with this access level shall be unable to access the portal unless a valid "Escort" cardholder presents their credential at the card reader within fifteen seconds after the "Requires Escort" credential has been presented. Otherwise, access will be denied and the Activity Log shall display a message with the reason code {NO ESCORT}.
15. The system shall support Facility Code Mode with the following available options.
- a. None (the default): The facility code is treated as part of the overall encoded credential number. A card matching only the facility code will not be granted access.
 - b. Configuration: Facility-code only checking is turned on only while the complete set of credentials is being downloaded to the Mercury panel. Once the credential download is complete, the behavior is the same as for the "None" setting.
 - c. Offline: Facility-code only checking is turned on only when the SIO is disconnected from its Mercury panel (via the RS-485 link). When the SIO is connected to the panel, the behavior is the same as for the "None" setting.
 - d. Configuration and Offline: Facility-code only checking is turned on both during the credential download and when the SIO is disconnected from its Mercury panel. At all other times, the behavior is the same as for the "None" setting.
 - e. Permanent: Facility-code only checking is turned on at all times.
16. Anti-passback - The system shall support both regional and timed anti-passback access control. For anti-passback functions, it shall be possible to configure regions, assign readers to those regions, and specify events for response to tailgate, passback, and occupancy limit violations. It shall also be possible to designate parent regions for hierarchical anti-passback.
- a. Grace: It shall be possible for a system Monitor or Administrator to Grace Card holders from passback and tailgate violations.
 - b. It shall also be possible to set a specific time for all cardholders to be graced daily.
 - c. The system shall be able to automatically place the cardholder in a predefined region upon the selection of the grace option.

17. Mustering - To aid in evacuation management it shall be possible to designate a region or regions for mustering. It shall be possible to quickly get an occupancy count and occupant list for any region.
18. Scheduled Actions - It shall be possible to specify system actions to occur at scheduled times. When scheduling an action, it shall be possible to specify whether the time specifications for the scheduled action will be based on the time zone set for the local Network Node or the time zone set for the Network Controller. Scheduled actions can include:
 - a. Arming and disarming inputs.
 - b. Activating and deactivating outputs.
 - c. Locking and unlocking portals.
19. Floor plans - The system shall be capable of displaying active graphic floorplans and configuring each floorplan with icons representing system resources: cameras, portals, temperature points, and alarms. A network administrator holding at least a "Setup" user role shall be able to upload floorplan images and graphically configure device icons onto the floorplan images. Viewing floorplans will require the Macromedia Flash Player 9.0 plug-in for the browser.
 - a. It shall be possible to create floorplan groups for the purpose of assigning or withholding assignment of these groups to system user permissions known as Custom User Roles. If a floorplan group is assigned to a particular system user then the floorplans in that group shall be viewable by that system user.
20. Elevator Control - The system shall be capable of controlling elevator access to floors. The system shall be capable of controlling up to 52 floor buttons per node. It shall be possible to create, change, or delete floor groups to assign a free access time specification to a floor group. The floors in this group will be freely accessible during the times defined by the chosen time specification.
 - a. It shall be possible to create elevator groups for the purpose of assigning or withholding assignment of these groups to system user permissions known as Custom User Roles. If an elevator group is assigned to a particular system user then the elevators in that group shall be viewable by that system user.
 - b. Users assigned to custom user roles for one or more elevator groups may be given Free Access privileges to manage access to the elevators in those groups by using the Scheduled Actions page or an Elevator Status widget to:
 - 1) Momentarily enable free access for an elevator floor button. This will allow persons to temporarily access one or more floors without the need for an access control transaction such as a card read.
 - 2) Schedule an extended period of free access to one or more floors. This will allow persons to access the floors without constraints for the duration of the free access schedule.
 - c. Floor Tracking - Users may configure optional inputs on the SMS that shall change state when a corresponding floor selection button on an elevator is pushed, enabling the system to monitor the status of each floor selection button in relation to specific access credential transactions.

- d. The system shall support Elevator Floor Tracking
 - 1) The system shall support optional inputs that change state when the corresponding floor-select buttons are pushed, allowing the system to detect each button's status.
 - 2) The system shall support an optional input that will change state and trigger an event, when the elevator's duress/emergency button is pushed.
- e. Users may configure an optional input for each elevator, and corresponding event on the SMS when the elevator's duress/emergency button is pressed.

V. Threat Levels:

- 1. It shall be possible to configure up to eight threat levels. It shall be possible to alter security system behavior through the use of threat levels. Groups of threat levels may be created and assigned to portal groups, access levels, input groups, output groups, floor groups, and event actions. The behavior of groups, access levels, and event actions with assigned threat level groups shall change based upon the current system threat level.
- 2. The S2 SMS shall support 32 threat level groups.
- 3. It shall also be possible to change the system threat level in response to an alarm event.
- 4. The current system threat level shall display in the title bar of the security application interface and on floorplans.

W. Location-based threat levels - The system administrator shall have the ability to define locations. This allows for threat levels to be assigned to individual locations.

- 1. Within each parent location, sub-locations can be created, and additional sub-locations can be created within each of these, and so on. This creates a location hierarchy.
- 2. Portals can be assigned, and threat levels applied, to any location within the hierarchy.

X. Appropriate Use banner - The system administrator shall have the ability to enter text (such as an appropriate use statement) to be displayed on the login page.

Y. Reports:

- 1. The S2 SMS shall be capable of producing a variety of predefined reports regarding software and security hardware configuration, event history, and the administration of people within the system. In addition, an easy to use query language shall be included to create ad hoc reports. The query language shall be documented in the online help system. Alternatively, it shall be possible to specify a query by use of point-and-click.
- 2. It shall also be possible to produce reports directly from the Network Controller based on data in archive files on FTP or SFTP servers, network attached storage, or the built-in hard drive.
- 3. The S2 SMS shall support a graphic interface for interactively building custom reports from either historical or personnel data. These reports shall be savable for later reuse. Parameters can be inserted into reports to prompt for data input at report runtime. Report results can be printed, output to a PDF file or put into a spreadsheet.

4. It shall also be possible to group reports for assignment to custom user roles. Any reports not grouped and assigned to a custom user role shall not be viewable by that system user.
5. The system shall be capable of sorting users by various criteria, including email address, and allow for email groups to be selected for auto-distribution.
6. Report generation shall not affect the real-time operation of the system.
7. The specific reports provided shall include the following:
 - a. Configuration Reports
 - 1) As Built - A graphical report that displays an image of each Application blade in a node and the specific resources (inputs, outputs, readers, etc.) configured for that blade. The network settings for the node shall also be included.
 - 2) Cameras - Displays all camera configuration information including control address, IP port, and camera type.
 - 3) Camera Presets - Displays configured presets for each camera in the system.
 - 4) Elevators - Displays elevator configuration information including node, reader, floor to output mappings, floor select and duress/emergency inputs.
 - 5) Floor Groups - Displays all configured floor groups for use in elevator control.
 - 6) Holidays -Displays holiday specification information.
 - 7) Portals - Displays portal definition information including reader, DSM input, REX input, alarm outputs, and events.
 - 8) Portal Groups - Displays a list of all defined portal groups.
 - 9) Reader Groups - Displays defined groups of readers.
 - 10) Remote Locksets - Available if the Remote Locksets feature is licensed for the system. Displays the following information for each remote lockset: name, IP address, synchronization status, serial number, last completed update time, firmware version, battery voltage, assigned remote lockset profile, and number of stored cardholders. The report can be sorted by any of the columns.
 - 11) Resources - Displays all configured system resources including readers, inputs, outputs, elevators, and temperature points.
 - 12) Threat Level Groups - Displays all configured threat level groups and the threat levels assigned to them.
 - 13) Threat Levels - Displays all configured threat levels including the description and color assignment.
 - b. History Reports
 - 1) Access History - Displays access history based on an entered query. The system user can specify the query using either the keyboard or point-and-click selection. Access history reports shall include the ability to include elevator access requests.
 - 2) Custom Report - This provides the capability to create custom reports of historical data. A graphic interface provides the user with the ability to interactively create and save reports for later use. Parameters can be inserted into reports to prompt for data input at report runtime. Custom report output shall be user selectable for HTML, PDF or CSV format. Custom report configuration shall include page size, orientation, column

- width and shall automatically notify the user if the selected configuration exceeds the selected page size.
- 3) General Event History - Displays time, type of activity, and activity details for a variety of event types. The system user can select the specific event types for the report.
 - 4) Portal Access Count - Display how many times users have used a portal.
 - 5) Audit Trail - Displays an audit trail of system changes and the name of the system user that made the changes. It shall be possible to specify the dates and times covered in the report.
 - 6) Duty Log - Displays duty log comments residing in the current security database, including archives. For each duty log comment, the report shows the date and time the comment was entered, the person who entered the comment, the date and time of the logged event associated with the comment, and the Activity Log message followed by the specific comment text.

c. People Reports

- 1) Access Levels - Displays all access levels entered into the system including time specification, reader/reader group, and floor group.
- 2) Credential Audit - Lists existing credentials by their current status settings (such as Active, Damaged, Lost, or Not Used). Before running the report, users can filter the data to see only credentials with a particular status setting, or only credentials that were not used with a specific number of days from the date they were issued.
- 3) Current Users - Displays a list of all security system users currently logged in to the security system website.
- 4) Custom Report - This provides the capability to create custom reports of personnel data. A graphic interface provides the user with the ability to interactively create and save reports for later use. Parameters can be inserted into reports to prompt for data input at report runtime. Custom report output shall be user selectable for HTML, PDF or CSV format. Custom report configuration shall include page size, orientation, column width, and shall automatically notify the user if the selected configuration exceeds the selected page size.
- 5) Occupancy - Displays a list of defined regions with the number of people currently occupying each region and the maximum number of occupants allowed, if a maximum has been specified.
- 6) Photo ID Gallery - Displays all the photo ID pictures in the system and the person's name.
- 7) Photo ID Requests - Displays all outstanding badge print requests and lists ID, name, badge layout, activation date, request date.
- 8) Portal Access - Lists people with access for a selected portal.
- 9) Roll Call - Allows you to select a defined Region from the drop-down and see a list of people currently in that region.
- 10) Roster - Displays every person entered into the system and it lists name, ID photo, expiration date, username, and access level.
- 11) Time Specifications - Displays all defined time specifications currently in the system.

- Z. Administration - The S2 SMS shall provide for the performance of system administration tasks from any network-connected computer with a browser. Most of the administrative, maintenance, and configuration utilities and functions shall require a S2 SMS user with at least a "Setup" user role. Information from the network administrator shall, in many cases, also be required. These administrative tasks shall include but not be limited to:

1. Generating reports:
 - a. The system shall be capable of producing a variety of predefined reports regarding software and security hardware configuration, event history, and the administration of people within the system.
 - b. Alternatively, the system shall support a graphic interface for interactively building custom reports from either historical or personnel data. These reports shall be savable for later reuse. Parameters can be inserted into reports to prompt for data input at report runtime. Report results can be printed, output to a pdf file or put into a spreadsheet.
 - c. It shall also be possible to group reports for assignment to custom user roles. Any reports not grouped and assigned to a custom user role shall not be viewable by that system user.
 - d. A system user holding "Administrator" permissions shall be able to view and create reports.
2. Database backups:
 - a. The system shall create database, or full system data backups, each night at 00:15 hours. These backups shall be stored in ROM and written to the drive on the disk-based controller.
 - b. Backups shall also be written to network attached storage (NAS), an FTP server, or an SFTP server if such storage has been configured in the system.
 - c. It shall also be possible for the system users to create such database backups at any time. Any database backups onboard the Network Controller may also be downloaded to off controller storage by the system user at any time.
3. System restore:
 - a. The system shall be able to restore its database, or the full system data, from a backup. Restoration of the system shall only be possible from a backup copy onboard the Network Controller. It shall, therefore, be possible to upload a copy of a database backup from any network attached storage.
 - b. It shall be possible to review backups by date and description and select the desired backup for upload to the Network Controller or restoration as the current system database.
4. Software updates:
 - a. Software updates, upgrades and patches shall be provided from time to time. The system shall be able to update its software from these .upg files. Update of the application software shall only be possible from an update file onboard the Network Controller. It shall, therefore, be possible to upload a copy of the software update from any network attached storage or from any PC drive or desktop.
 - b. Software updates may involve the Network Controller only or may include updates for the node(s) also. The monitoring of the security system may be unavailable for several minutes during this process.

5. File upload - The system shall support uploads of files for use in and with the system. Files which shall be uploadable include:
 - a. Floorplans in jpg format
 - b. Badge layouts
 - c. ID photos in jpg format
 - d. Database backups
 - e. Software license files
 - f. software updates
 - g. Threat level icons in jpg format
 - h. Sound files (.wav) for use in event alerts
6. Setting system time, time zones, and time servers:
 - a. The S2 SMS shall support the setting of time zones by selection off of a drop down pick list. Time zones shall be separately settable for the controller and for each node or MicroNode in the system. An extensive list of world-wide time zones shall be provided. Adjustments for daylight saving time (summer time) shall be automatic.
 - b. The S2 SMS shall support the use of network time servers. Up to three time servers can be designated. Use of a network time server ensures that the Network Controller and its nodes will be regularly synchronized with the exact time used by all other network resources.
 - c. It shall also be possible to manually set the system date and time.
7. Changing passwords:
 - a. Person data maintained in the system may also contain a user name and password for logging on to the security application website as a system user. The system shall support the changing of administrator passwords. It shall be required to enter the password twice for verification purposes.
 - b. Administrators shall be able to specify a minimum number of characters that users must include in their login passwords.
 - c. Administrators shall be able to specify that users' login passwords must contain a combination of letters, numbers, and special characters.
 - d. Administrators shall be able to set a password expiration period in months (from 1 month to 12 months) for all passwords in the current partition. Whenever a user changes his or her password, it will remain in effect for the selected number of months.
 - e. It shall also be possible to integrate an LDAP or SLDAP server for single-user logon authentication. This will reference the LDAP-stored password for use by the system.

8. Issuing and revoking cards (credentials):
 - a. Access cards shall be assignable by the system user either by entering card data directly into the person record or by use of an enrollment reader. Access levels shall be assignable through the user interface by selection from the list.
 - b. Access cards shall be revocable at any time. A system user holding at least the Administrator user role may perform this action. Revoked cards shall stop functioning immediately.
 - c. A system user holding at least the Administrator role may also disable an access card by changing its Active status to Clear, Damaged, Disabled, Expired, Forgotten, Lost, Missing Active, Missing Disabled, Not Returned, Not Used Not Validated, Returned, Stolen, Suspended or Temporary Expired. The card will not function with any of these status settings (unless the setting has been customized, as described below). Running a Credential Audit report shall allow existing cards to be viewed by their current status settings.
 - d. A system user holding at least the Administrator role may customize any of the following access card status settings: Clear, Damaged, Forgotten, Lost, Not Returned, Not Validated, Returned, Stolen or Suspended. The user can change the name and/or description of the status setting, and can specify that a card to which the setting is applied will continue to function.
 - e. A maximum number of active cards per person can be enabled for the system. Once a person has reached the system limit, a new card can be added for that person only if one of his or her active cards is revoked or disabled.
 - f. When "Enable credential profiles" is selected on the Network Controller page, it shall be possible to assign credential profiles to individual credentials to determine the number of days of non-use before they expire.
 - g. It shall be possible to set expiration dates for individual credentials in a person record. When a controller encounters an expired person record during its nightly system check, it shall modify that person record from "Active" to "Expired". Similarly, if an expired person record is set to "Temporary", it shall be changed to "Temporary Expired".
 - 1) In order to reactivate "Expired" and "Temporary Expired" credentials, a system user with appropriate user role permissions may edit the person record in the User Interface, and modify the expiration date to a future date/time. Once the record is saved, the person record status will be changed to "Active" or "Temporary".
 - h. It shall be possible to specify that any credential not used within a specific number of days from the date it was issued will be disabled automatically.
 - i. The "First Name", "Middle Initial", and "Last Name" fields of each Person Record shall allow for up to 50 characters each.
 - j. The system shall provide for a workflow to be configured to facilitate processing of lost and/or forgotten credentials.
 - k. The system shall track credential status information and make it available for use in creating up-to-the-minute credential status reports.

9. Enrolling new people:
 - a. All person data entered into the system shall be held in the system database and shall be available only to system users holding at least the Administrator user role.
 - b. Person data can be added, deleted, and edited by users holding at least the Administrator user role.
 - c. The system shall support person record templates.
 - 1) Each template defines values for specific fields, such as a default set of access levels.
 - 2) These values will be filled in automatically in any person record created from the template.
 - 3) When adding a person to the system, a user shall be able to use one of the available templates in the active partition to create the person record, or create it without a template.
 - 4) Person Record Templates shall be available for use in custom People report definitions and in person search criteria.
10. Creating Photo IDs - The system shall include an integrated photo ID function. It shall be possible:
 - a. To design badge layouts.
 - b. To upload badge layouts for badge printing.
 - c. To capture ID photo images, print badges, and delete uploaded badge layouts.
 - d. For the system user to manage all photos ID functions entirely from within the browser.
 - e. To track the number of times a badge has been printed.
 - f. To print multiple badges at once using the Badge Print Workflow.
 - g. To enroll a person's card number manually or through a reader and save the new credential from the Badge Print Workflow.
 - h. The system shall be capable of automatically generating auto-incremental encoded credential numbers. Each new encoded credential number shall be increased by one over the next highest number in the system.
11. Configuring network resources:
 - a. DNS - The system shall support setting IP addresses for up to two domain name servers.
 - b. Email settings - The system shall support the use of email notifications of alarm events. The system user must setup the email server IP address or DNS name and the email address of the Network Controller. A network administrator must setup the network mail server to relay email for the IP address of the Network Controller.

- 1) When setting up an email relay, users shall be able to select a port number other than 25 to indicate that the system should attempt to use encrypted SSL connections for the outgoing messages. If an encrypted connection is not available, then the system will fall back to port 25 for an unencrypted connection.
 - c. File transfer protocol (FTP) - The system shall support the use of an FTP or SFTP Server for backups. Once configured, backups are automatically saved to the FTP server each night.
 - d. NAS - The system shall support the use of network attached storage devices for backups. The network administrator must create a domain user account for the Network Controller and a password. The system user must configure the network attached storage in the system including the domain name, server IP address, share name, and the directory where the Network Controller may store data.
 - e. Time Servers - The system shall support the use of network time servers. Up to three time servers can be designated. Use of a network time server ensures that the Network Controller and its nodes will be regularly synchronized with the exact time used by all other network resources.
 - f. A system user holding "Setup" User Role shall be able to configure network resources.
12. LDAP/SLDAP - It shall be possible to configure an Active Directory Server with the S2 SMS.
- a. This shall provide single user-login capability.
 - b. Password rules and authentication will be governed by the LDAP server.
13. Data Operations:
- a. View – Users having the "Data Operations: View" user role permission shall be able to view the results of data operations. Depending on which other user permission roles assigned to them, they may also be able to add person records (including access level, credential, and user defined person record information) to the S2 SMS, and modify and delete existing person records.
 - b. Import File – Shall enable the user to manually upload (import) tab-separated or comma-separated (CSV) text files.
 - c. Export File – Shall enable the user to manually download (export) CSV text files.
 - d. Automatic Import – Shall enable the system to process an Import File at scheduled intervals from a pre-configured NAS location.
 - e. NetBox Application Programming Interface (NBAPI) – Shall provide the user interface to import CSV data to the S2 NetBox SMS. The NBAPI shall also be the interface for exporting the entire set of current access level and credential configuration of existing person records from an S2 NetBox SMS to an external target system. (NBAPI is not supported for S2 Global systems)

2.7 VIDEO MANAGEMENT SYSTEM INTEGRATION

- A. General: The S2 NetBox[®]/NetBox[®]VR/Enterprise[®] SMS shall support the integration of certain Network Video Recorders (NVR). This integration shall allow the viewing of live streaming video in the browser interface and recorded video playback. Viewing live streaming video shall require the Java™ 2 Runtime Environment version 1.4.2 or version 5.0.
1. Events in the alarm subsystem can initiate video recording. Video motion detection, camera up and camera down messages from the VMS can initiate alarms.
 2. It shall be possible to monitor DVR and NVR cameras in the same views as IP cameras. VMS events shall be logged in the system activity log. It shall be possible to view recorded video of events from the Activity Log.
 3. It shall be possible to view live cameras through floor plans, on the camera view pages, on the Monitoring and Widget Desktops.
 4. It shall be possible to pull up recorded video through reports.
- B. NetVR Appliances (NetVR and NetBoxVR):
1. NetVR appliances must integrate with S2 Security systems access control, event monitoring, and video management into a single user interface for: live viewing, forensic searching and video exporting.
 2. S2 NetBox VR should be a fully self-contained video management appliance or a one box unit with both an access control system and video management appliance, also containing a database, an operating system and application software, as well as raw video storage.
 3. Multiple NetVR appliances can be connected to SMS controllers as follows:
 - a. Up to 4 subordinate NetVRs supporting up to 32 cameras, with one NetBox
 - b. Up to 3 subordinate NetVRs supporting up to 32 cameras with one NetBox VR
 - c. Up to 8 subordinate NetVRs supporting up to 128 cameras with one NetBox Extreme
 - d. Unlimited subordinate NetVRs supporting up to 1024 cameras with one Enterprise Exacta 50 system
 - e. Unlimited subordinate NetVRs and cameras with one Enterprise Exacta 100 system
 4. Shall use browser-based functionality; runs with Internet Explorer 9 or 11 with the use of an installed video accelerator
 5. Natively supports either 8 or 16 cameras, dependent on licensing.
 6. Shall support video surveillance features, including:
 - a. Real-time surveillance video integrated on the home page, the Monitoring Desktop, and the Widget Desktop

- b. Viewer-adjustable single camera and multi-camera views (2x2 or 1+7), presets, and camera tours
 - c. Calling up cameras through events and through floor plans
 - d. Adjust camera with PTZ controls, enabled through UI controls, using mouse or joy stick
 - e. Adjust video quality and frame rate in video viewer
 - f. Browse video from anywhere that has permitted access to the network and has the accelerator installed
 - g. Displays a blue border when there is motion in the frame
 - h. Provides the ability to organize surveillance tools using favorite cameras, camera categories, and change sort order.
7. Shall support Forensic Desktop for video investigation, including:
- a. Supports video recording and playback
 - b. Provides tools to search through recorded video from multiple cameras and NetVR appliances to quickly locate one or more video clips pertaining to a security event
 - c. Provides graphical frame displays of individual camera streams
 - d. Allows use of a Forensic Activity Log to get to a particular event
 - e. Allows the use of date/time or camera thumbnails to search for video
 - f. Provides an adjustable thumbnail stride length to select the interval of the clips searched
 - g. Displays yellow vertical bars between thumbnails to indicate there is a gap greater than the stride length
 - h. Displays a yellow outline of the viewer window to indicate recorded video is displayed
 - i. Can play back video by clicking icons in the forensic activity log, use date/time, access control reader, alarm, person's name
 - j. Play video in segments or frame-by-frame
 - k. Can build cases by saving multiple clips into a case file, which is then cataloged in the case library
 - l. Clip view displays all the clips in a case
 - m. Can print individual frames, including metadata and implied data
 - n. Create, save, and export clips of interest

- o. Can export clips in proprietary format with a digital signature, or as AVI file with included video player provided
- p. Allows video searches using the metadata within the Forensic Activity Log, such as searching for events related to a person or a portal.
- q. Supports Codecs, H.264 and MJPEG.

C. Third-party Video Integration Functionality

1. Third party VMS integration shall be performed by using the S2 Open Video Interface Document (OVID)
2. A TCP/IP connection shall be established between the SMS and the third-party VMS.
3. The Integration shall:
 - a. Trigger video recordings.
 - b. Trigger preset commands.
 - c. Be capable of PTZ control.
 - d. Be capable of recalling recorded video.
 - e. Receive motion events.
 - f. Receive video loss events.
 - g. Receive video restore events.

D. Integrated DVR/NVR Systems:

1. Cisco - VSOM
2. exacq – exacqVision – Including exacqVision Server Version 6.4
3. Milestone Systems – XProtect Enterprise, XProtect Professional, XProtect Corporate
4. OnSSI – NetDVMS, NetDVR, Ocularis IS 2.0, Ocularis CS 2.0
5. Salient Systems CompleteView NVR
6. Video Insight Server
7. Avigilon Control Center (ACC) software 4.10.x, 5.2

E. Open Video Interface Driver (OVID) API:

1. This specification defines an API to implement the integration of video surveillance systems with the S2 SMS.
2. The OVID API shall allow users to monitor and control one or more video servers along with their associated video cameras, to augment the physical security devices (door locks, card readers, etc.) controlled by the S2 SMS.

3. The integrated system shall be controlled through a web browser user interface which presents an integrated view of both the S2 SMS and the video surveillance system.

2.8 MERCURY AND MERCURY POWERED HARDWARE INTEGRATION

- A. The S2 SMS shall support the integration of access control hardware from Mercury Security Corp.
- B. The following Mercury hardware components shall work with the S2 Controller:
 1. Supported Mercury Panels:
 - a. EP2500: Intelligent Controller: 32 MB RAM, Ethernet
 - b. EP1502: Intelligent Dual Reader Controller: 16 MB RAM, Ethernet, 2 readers) 8 inputs, 4 relays
 - c. EP1501: Intelligent Single Door Controller: PoE, single door, 2 readers, 2 inputs, 2 outputs
 - d. Mercury firmware version 1.14.8 is supported on the above panels.
 2. Supported Mercury Interface Boards (SIOs):
 - a. MR-50 Reader Interface Module: 1 reader (magnetic stripe or Wiegand), 2 inputs, 2 relays
 - b. MR-52 Reader Interface Module: 2 readers (magnetic stripe or Wiegand), 8 inputs, 6 relays
 - c. MR-16in Input Monitor Module: 16 inputs (zones), 2 relays
 - d. MR-16out: Relay Output Control Module: 16 relays
- C. The S2 NetBox®, NetBox Extreme, Exacta50 and Exacta100 systems shall support the following hardware:
 1. Mercury M5 Devices: Legacy Mercury Casi Micro/5 enclosures using Mercury M5 Bridge boards to replace existing Casi boards.
 - a. Casi F2F readers and keypads shall be supported for Mercury M5 Bridge 2RP, 2SRP, and 8RP panels.
 2. Schlage Wireless Devices: Mercury connected Schlage AD-400 wireless locks and WRI400 wireless access point modules via PIM-400 module.
 3. Honeywell PW Series Devices: Mercury powered PW Series devices controlled and connected to intelligent control module PW6K1IC.

2.9 OTIS ELEVATOR COMPASS™ SYSTEM INTEGRATION

- A. The system shall support the integration of the Otis Elevator Compass™ Destination Entry System with the S2 NetBox®/NetBox®VR/Exacta50 and Exacta100 Security Management

systems. The Compass system is designed to optimize the use of elevators in large office buildings.

1. The boundary between the Compass network and the S2 SMS network is a Layer 3 switch. This switch routes two-way data traffic between the S2 Controller and the Compass nodes, using the TCP/IP networking protocol.
2. The S2 Controller acts as the central processor for the security system. A single controller can supervise the operation of many nodes. It also manages all communication between the S2 SMS and the Compass system.
3. The S2 Network Node is a peripheral processor which handles building security hardware such as card readers. A node can control many readers.
4. Once the system has been initialized to support an interface to the Compass system, standard S2 SMS configuration pages can be used to configure the Compass system:
 - a. The Status page lets users view the Compass IP network configuration information, such as node status.
 - b. The Floor Map page lets users configure the floor mapping needed to identify the building floors by name and floor.
 - c. The Configuration page lets users configure the destination entry server (DES) nodes, destination entry director (DER) nodes, and destination entry computer (DEC) nodes in the Compass system.
 - d. The Events page lets users view the IP address, name, node type, and status of each node in the Compass system.
 - e. The Reader Groups and Access Levels pages let users configure reader groups and their associated access levels within the Compass system.

2.10 REMOTE LOCKSET INTEGRATION

- A. The S2 SMS shall support the integration of ASSA ABLOY Wi-Fi enabled locksets (models v.S2, p.S2, and IN120) and PoE locksets (models v.S1 and p.S1) with the SMS.
 1. The system shall support more than 500 remote locksets; each S2 controller configuration shall be rated for the number of locksets it can support.
 2. Once a lockset is installed and registered with the controller, it appears in the security application as a "remote lockset" node, which can be enabled and configured to work with the controller.
 3. When a remote lockset connects to the controller, it shall report its power type, which is encoded in its serial number.
 - a. A lockset reporting having PoE or direct hardwired power shall be treated as an online lockset and assigned the Default (Online) lockset profile.
 - b. A lockset reporting having only batteries as a power source (such as a Wi-Fi lockset) shall be treated as an offline lockset and is assigned the Default (Offline) lockset profile.

- c. The offline remote lockset shall update the controller with the current voltage level of its battery upon each connection.
 - d. Clearing the “Online” check box on the Advanced tab of the Network Nodes page will change an online lockset communication status to offline.
 - e. The default lockset profile automatically assigned to the lockset the first time it connects to the system shall be editable.
4. It shall be possible to set configuration options for a remote lockset to change its call-in and unlock behaviors.
 5. It shall be possible to configure the reader and portal that were automatically created for a remote lockset.
 6. It shall be possible to view cached information for a remote lockset, for troubleshooting purposes.
 7. It shall be possible to specify special-use formats for access cards to be used with remote locksets.
 8. The remote lockset shall be able to send high priority events to the controller.
 9. It shall be possible to schedule an automatic unlock period for remote-lockset portals. The start of this period can be triggered by time or by an initial valid card read.
 10. It shall be possible to select a check box when creating a magnetic stripe ABA Track 2 card format to ensure that the format will be recognized by remote locksets with magnetic stripe card readers.
 11. It shall be possible to create remote lockset profiles to assist in the configuration and management of large numbers of remote locksets. A lockset profile is a defined set of attributes that affect lockset behaviors. Assigning a profile to a lockset gives it the attributes defined in the profile. Any subsequent changes made to the profile are applied to the lockset automatically.
 12. Locksets shall support PIN-only credentials.
 13. It shall be possible to specify a voltage level below which an offline lockset will go into power saving mode. If a Low Battery event is enabled for the lockset, the event will be triggered. Once the battery is replaced, the lockset will leave power saving mode only when the voltage level reaches 1.5 volts higher than its current Low Voltage setting.
 14. It shall be possible for a lockset to check for permissions with the host (controller) for a person that is not yet stored in the lockset.
 15. Online locksets shall have the same capabilities as offline locksets with the following additional capabilities:
 - a. Online locksets can be assigned to locations; changes to a location’s threat level can cause the locksets in that location to enter and exit panic mode.
 - b. Online locksets shall have momentary unlock capability while in panic mode (by means of an event action or button on the portal status page).

- c. Online locksets shall be capable of persistent unlock or lock mode (by means of an event action or button).
- d. Online locksets can be added and managed in floorplans.
- e. Online locksets can be unlocked momentarily via event actions or from the Portal Status page, the Widget Desktop, the Monitoring Desktop, or a floorplan.
- f. Online locksets shall be capable of performing scheduled locks or unlocks via, event actions, or from buttons on the Portal Status page, the Widget Desktop, the Monitoring Desktop, or a floorplan.
- g. Online locksets shall be capable of being switched to a locked or unlocked state, and be disabled or enabled using buttons on the Portal Status page.
- h. Online locksets shall be capable of being enabled and disabled via buttons on the Portal Status page.
- i. Activity associated with an online lockset can be viewed in real time in the Activity Log.

2.11 S2 MOBILE SECURITY OFFICER™ APPLICATION

- A. The S2 Mobile Security Officer™ (S2 MSO) shall be a mobile application for use with Apple iPad tablets running iOS7.1. The S2 MSO shall enable wireless tablet users to monitor and control various features of the SMS.
 - 1. Activity Monitoring – Users shall be able to view recent activity from the SMS activity log. Users shall be able to select specific activity log entries to view associated records, such as person record details, play live and recorded video, and change the status of specific portals.
 - 2. View Person Details – Users shall be able to search for persons by name, and view associated person records. Users shall be able to photograph persons using the camera on their tablet, and record these in the SMS.
 - 3. Live Video Monitoring – Users shall be able to display thumbnail images of every NetVR camera view integrated with the SMS. Users shall be able to select individual thumbnails, which shall display live video from the corresponding camera.
 - 4. Mobile Mustering - The application shall support a mustering process using a mobile device to allow regional evacuation, unimpeded by access control constraints. Users shall be able to initiate and terminate multiple evacuations simultaneously. The system shall enable users to determine if all persons known to be present within a given region have been accounted for. The system shall be capable of managing mustering points simultaneously.
 - 5. The S2 MSO shall support up to five simultaneous iPad connections per S2 Controller.

2.12 THIRD PARTY SSL CERTIFICATE SUPPORT

- A. It shall be possible to configure an SSL certificate that will provide encryption alone, or encryption plus authentication. The available options are:

1. Generating a self-signed SSL certificate, this is signed with the embedded web server's own private key. This certificate shall provide encryption but not authentication.
2. Generating an SSL certificate that is signed by a certificate authority (CA). This certificate shall provide both encryption and authentication.
3. Uploading your own SSL certificate and matching key to the controller. Optionally, it shall be possible to upload a chain, or intermediate, file that links the certificate to a trusted root certificate.

2.13 PIVCHECK INTEGRATION (Codebench)

- A. The S2 SMS shall support the integration of Codebench's PIVCheck PIV/TWIC/CAC/FRAC. This integration allows for:
 1. Support for FIPS-201 Credentials
 2. Authentication of PIV, TWIC, CAC, and FRAC credentials.
 3. Validation against a certificate revocation list.
 4. Enrollment of information contained within the credential imported directly into the NetBox database.

2.14 VISITOR MANAGEMENT SYSTEMS INTEGRATION

- A. The S2 SMS shall be able to integrate with a variety of industry leading visitor management products. The integration allows for visitor information to be shared with S2 SMS, providing the ability to assign credentials to visitors as well as running reports on activity. There is no additional cost or license fee from S2 for integrating with these visitor management systems with the S2 SMS application.
- B. These Companies have written API to integrate to S2 SMS:
 1. Jolly
 2. EasyLobby (owned by HID)
 3. Stop Ware
 4. iVisitor
- C. Fees associated with integration of third-party visitor management systems may be applicable, depending on the manufacturer.

2.15 API INTEGRATION

- A. An application programming interface (API) is provided for the S2 NetBox[®]/NetBox[®]VR/Enterprise[®] SMS. The API provides programmatic access to the network-connected components managed by the S2 SMS.

1. Communication between the S2 SMS and another application takes place through the TCP/IP networking protocol. The API is invoked by posting an HTTP message to the web server on the S2 Network Controller.
2. The S2 SMS database includes a table of “people” whose records act as container objects for attributes attached to people in real life. People are mapped to access levels, which specify access privileges—and to access cards, whose credentials are used for access control.
3. Access levels are created in the system using the normal web user interface for the S2 SMS. People and credentials may be entered into the system either through the web user interface or through the API.
4. The API supports commands for:
 - a. Adding, modifying, removing, and retrieving data about a person, and retrieving information about one or more people based on various search criteria.
 - b. Adding, modifying, and removing credentials, and retrieving a list of the names of defined card formats.
 - c. Adding, modifying, and deleting access levels, and retrieving a list of the valid access levels in the system.
 - d. Pinging the S2 SMS to determine its health, and retrieving the current version of the API from the server.
 - e. Retrieving a history of access activity, either for all users or for a particular access card.
 - f. Adding, modifying, and removing threat levels and threat level groups, and setting the threat level in the system.
 - g. Retrieving a list of portals and associated card readers defined for the S2 SMS.
 - h. Adding, modifying, deleting, and retrieving time specifications and time specification groups.
 - i. Adding, modifying, and deleting holidays, and returning a list of holiday keys or a specific holiday.
 - j. Adding, modifying, deleting readers and reader groups, and returning a list of reader group keys or information for a specific reader group.
 - k. Adding, modifying, and deleting portals and portal groups, and retrieving information about a specific portal group.
 - l. Requesting events from the Activity Log that occurred within a specified time period. These events are returned from the API in the CSV Export report format.

2.16 HIGH AVAILABILITY (HA) SOLUTION

- A. The system shall support S2’s Exacta high availability (HA) option. The Exacta HA solution includes two HA servers running Stratus Avance software. They act as a platform for the S2

software and operating system as a virtual machine on one server, which is continually backed up on another.

1. A Hot Standby implementation shall use a failover cluster consisting of a pair of identical co-located controllers. One controller shall have the primary, or active, role and the other a secondary or passive role.
2. The Hot Standby implementation shall support operation from either controller, but not from both simultaneously. Under normal redundant operation, the primary controller shall perform all operations and shall mirror its data onto the secondary controller.
3. The two controllers shall be linked by a heartbeat network connection they shall use to monitor and communicate with each other. They shall share a virtual IP address to be used for communications with nodes and other devices.
4. Should the primary controller fail, the secondary controller shall be available to provide service through a process called failover. Administrators shall be alerted that a failover has occurred so they can take appropriate measures to restore the Hot Standby implementation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine cable pathways including conduit, raceways, cable trays, and other pathway elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.
- B. Examine rough-in for control cable and conduit systems to controllers, card readers, and other EACS components to verify conduit and back-box locations prior to installation of EACS devices
- C. Examine available network capacity and support infrastructure. Consult with network administrator for compliance with network standards and capacity.
- D. Examine install location for compliance with space allocations, installation tolerance, hazards to safe system operation, and other conditions affecting installation.
- E. Examine roughing-in for LAN, WAN, and IP network before device installation.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with SIA CP-01 Control Panel Standard.
- B. Comply with ANSI/TIA-606-B Labelling Standard.
- C. Prepare detailed project planning forms for programming and configuration of the SMS. Fill in all data available from project plans and specifications and publish as project planning documents for review and approval. These may include (but are not limited to):
 1. Define SMS Partitions.

2. For each Location, record setup of controller features and access requirements.
 3. Propose start and stop times for time zones and holidays, and match up access levels for doors.
 4. Set up groups, facility codes, software triggers, and list inputs and outputs for each controller.
 5. Assign action message names and compose messages.
 6. Set up alarms. Establish trigger actions between events and video surveillance features.
 7. Prepare and install alarm graphic maps.
 8. Develop user-defined fields.
 9. Develop screen layout formats.
 10. Discuss badge layout options; design badges.
 11. Complete system diagnostics and operation verification.
 12. Prepare a specific plan for system testing, startup, and demonstration.
 13. Develop acceptance test concept and, on approval, develop specifics of the test.
 14. Develop cable and asset-management system details; input data from construction documents. Include system schematics and technical drawings in electronic format.
- D. In meetings with Architect and Owner, present Project planning documents and review, adjust, and prepare final programming and configuration documents. Use final documents to program and configure SMS software.

3.3 CABLING

- A. Comply with NECA 1, "Good Workmanship in Electrical Construction".
- B. Install cables and wiring according to requirements in Section 280513 "Conductors and Cables for Electronic Safety and Security."
- C. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters. Conceal raceway and wiring except in unfinished spaces.
- D. Install LAN cables using techniques, practices, and methods that are consistent with Category 5E OR 6 rating of components and fiber-optic rating of components, and that ensure Category 5E OR 6 and fiber-optic performance of completed and linked signal paths, end to end.
- E. Junction boxes and enclosures containing security-system components or cabling, and which are easily accessible to employees or to the public, shall be provided with tamper resistant fasteners and/or tamper detection switches. In addition, hinged enclosure doors shall be equipped with locking hardware. Boxes above ceiling level in occupied areas of the building shall not be considered accessible. Junction boxes and small device enclosures below ceiling

level and easily accessible to employees or the public shall be covered with a suitable cover plate and secured with tamperproof screws.

- F. Install end-of-line resistors at the field device location and not at the controller or panel location.

3.4 CABLE APPLICATION

- A. Comply with TIA 569-C, "Commercial Building Standard for Telecommunications Pathways and Spaces."
- B. Card Readers and Keypads and Peripheral Devices:
 - 1. Install number of conductor pairs recommended by device manufacturer for the functions specified.
 - 2. Follow device manufacturer's installation requirements for maximum cable distances and sizes.

3.5 GROUNDING

- A. Comply with Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Comply with IEEE 1100, "Recommended Practice for Power and Grounding Electronic Equipment."
- C. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- D. Signal Ground:
 - 1. Terminal: Locate in each equipment room and wiring closet; isolate from power system and equipment grounding.
 - 2. Bus: Mount on wall of main equipment room with standoff insulators.

3.6 IDENTIFICATION

- A. In addition to requirements in this article, comply with applicable requirements in Section 260553 "Identification for Electrical Systems" and with TIA/EIA 606-B.
- B. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - 1. All wiring conductors connected to terminal strips shall be individually numbered, and each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with the name and number of the particular device as shown.
- C. At completion, cable and asset management documentation shall reflect as-built conditions.

3.7 SYSTEM SOFTWARE AND HARDWARE

- A. Develop, install, and test software and hardware, and perform database tests for the complete and proper operation of systems involved. Assign software license to Owner.

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections:

- 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

- B. Tests and Inspections:

- 1. LAN Cable Procedures: Inspect for physical damage and test each conductor signal path for continuity and shorts. Test for faulty connectors, splices, and terminations. Test according to TIA/EIA 568-C, "Commercial Building Telecommunications Cabling Standards - Part 1: General Requirements." Link performance for UTP cables must comply with minimum criteria in TIA/EIA 568-C.
- 2. Test each circuit and component of each system. Tests shall include, but are not limited to, measurements of power-supply output under maximum load, signal loop resistance, and leakage to ground where applicable. System components with battery backup shall be operated on battery power for a period of not less than 10 percent of the calculated battery operating time. Provide special equipment and software if testing requires special or dedicated equipment.
- 3. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.

- C. Devices and circuits will be considered defective if they do not pass tests and inspections.

- D. Prepare test and inspection reports.

3.9 STARTUP SERVICE

- A. Engage a factory-authorized service representative to supervise and assist with startup service.
- B. Complete installation and startup checks according to approved procedures that were developed in "Preparation" Article and with manufacturer's written instructions.
- C. Enroll and prepare badges and access cards for Owner's operators, management, and security personnel.

3.10 ADJUSTING

- A. Occupancy Adjustments: When requested within 30 days of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project for this purpose. Tasks shall include, but are not limited to, the following:

1. Check cable connections.
2. Check proper operation of card readers, intrusion sensors, integrated systems, and database configuration. Verify SMS configuration and adjust settings needed.
3. Recommend changes to SMS configuration and settings to improve Owner's use of SMS.
4. Provide a written report of adjustments and recommendations.

3.11 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the SMS equipment.
- B. Develop and provide separate training modules for the following:
 1. Computer system administration personnel to manage and repair the LAN and databases and to update and maintain software.
 2. Operators who prepare and input credentials, monitor the SMS, and to enroll personnel.
 3. Security personnel.
 4. Hardware maintenance personnel.
 5. Corporate management.

END OF SECTION

SECTION 283111

DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Heat detectors.
5. Notification appliances.
6. Device guards.
7. Remote annunciator.
8. Addressable interface device.
9. Digital alarm communicator transmitter.

- B. Related Requirements:

1. Section 280513 "Conductors and Cables for Electronic Safety and Security" for cables and conductors for fire-alarm systems.

1.3 DEFINITIONS

- A. EMT: Electrical Metallic Tubing.
- B. FACP: Fire Alarm Control Panel.
- C. NICET: National Institute for Certification in Engineering Technologies.
- D. PC: Personal computer.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product, including furnished options and accessories.
 1. Include construction details, material descriptions, dimensions, profiles, and finishes.
 2. Include rated capacities, operating characteristics, and electrical characteristics.
- B. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Provide program report showing that air-sampling detector pipe layout balances pneumatically within the airflow range of the air-sampling detector.
12. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.
 - a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
 - b. Show field wiring required for HVAC unit shutdown on alarm.
 - c. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' control system.
 - d. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' smoke-evacuation system.
 - e. Locate detectors according to manufacturer's written recommendations.
13. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
14. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

C. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire-alarm system design.
 - b. NICET-certified, fire-alarm technician; Level III minimum.
 - c. Licensed or certified by authorities having jurisdiction.

D. Delegated-Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Drawings showing the location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the device.
2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.

3. Indicate audible appliances required to produce square wave signal per NFPA 72.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.

1.6 Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 - c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
 - d. Riser diagram.
 - e. Device addresses.
 - f. Air-sampling system sample port locations and modeling program report showing layout meets performance criteria.
 - g. Record copy of site-specific software.
 - h. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
 - 1) Equipment tested.
 - 2) Frequency of testing of installed components.
 - 3) Frequency of inspection of installed components.
 - 4) Requirements and recommendations related to results of maintenance.
 - 5) Manufacturer's user training manuals.
 - i. Manufacturer's required maintenance related to system warranty requirements.

- j. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

B. Software and Firmware Operational Documentation:

- 1. Software operating and upgrade manuals.
- 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
- 3. Device address list.
- 4. Printout of software application and graphic screens.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- 1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
- 2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
- 3. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
- 4. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
- 5. Keys and Tools: One extra set for access to locked or tamperproofed components.
- 6. Audible and Visual Notification Appliances: One of each type installed.
- 7. Fuses: Two of each type installed in the system. Provide in a box or cabinet with compartments marked with fuse types and sizes.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II technician.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.

- 1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
- 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Source Limitations for Fire-Alarm System and Components: Components shall be compatible with, and operate as an extension of, existing system. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.
- B. Noncoded, UL-certified addressable system, with multiplexed signal transmission and voice/strobe evacuation.
- C. Automatic sensitivity control of certain smoke detectors.
- D. All components provided shall be listed for use with the selected system.
- E. 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.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
 - 1. Manual stations.
 - 2. Heat detectors.
 - 3. Flame detectors.
 - 4. Smoke detectors.
 - 5. Duct smoke detectors.
 - 6. Automatic sprinkler system water flow.
- B. Fire-alarm signal shall initiate the following actions:
 - 1. Continuously operate alarm notification appliances, including voice evacuation notices.
 - 2. Identify alarm and specific initiating device at fire-alarm control unit and remote annunciators.
 - 3. Transmit an alarm signal to the remote alarm receiving station.
 - 4. Unlock electric door locks in designated egress paths.
 - 5. Release fire and smoke doors held open by magnetic door holders.
 - 6. Activate voice/alarm communication system.
 - 7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
 - 8. Close smoke dampers in air ducts of designated air-conditioning duct systems.
 - 9. Record events in the system memory.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
 - 1. Valve supervisory switch.
 - 2. User disabling of zones or individual devices.
 - 3. Loss of communication with any panel on the network.
- D. System trouble signal initiation shall be by one or more of the following devices and actions:
 - 1. Open circuits, shorts, and grounds in designated circuits.
 - 2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.

3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
4. Loss of primary power at fire-alarm control unit.
5. Ground or a single break in internal circuits of fire-alarm control unit.
6. Abnormal ac voltage at fire-alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire-alarm control unit or annunciator.
10. Voice signal amplifier failure.

E. System Supervisory Signal Actions:

1. Identify specific device initiating the event at fire-alarm control unit and remote annunciators.
2. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.
3. Transmit system status to building management system.

2.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to ASCE/SEI 7 .

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.4 FIRE-ALARM CONTROL UNIT

A. Acceptable Manufacturers:

1. EST; United Technologies.
2. Silent Knight; Honeywell.
3. Fire-Lite Alarms; Honeywell.
4. Potter
5. Notifier

B. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.
 - a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
 - b. Include a real-time clock for time annotation of events on the event recorder and printer.
 - c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
 - d. The FACP shall be listed for connection to a central-station signaling system service.
 - e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.

2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
 3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.
- C. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
1. Annunciator and Display: Liquid-crystal type, 80 characters, minimum.
 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.
- D. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
1. Pathway Class Designations: NFPA 72, Class A .
 2. Pathway Survivability: Level 1.
 3. Install no more than 80% of the manufacturer recommended limit of addressable devices on each signaling-line circuit.
- E. Notification-Appliance Circuit:
1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
 2. Where notification appliances provide signals to sleeping areas, the alarm signal shall be a 520-Hz square wave with an intensity 15 dB above the average ambient sound level or 5 dB above the maximum sound level, or at least 75 dBA, whichever is greater, measured at the pillow.
 3. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.
- F. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.
- G. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.
- H. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided as a special module that is part of fire-alarm control unit.
1. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711.
 - a. Allow the application of, and evacuation signal to, indicated number of zones and, at the same time, allow voice paging to the other zones selectively or in any combination.
 - b. Programmable tone and message sequence selection.
 - c. Standard digitally recorded messages for "Evacuation" and "All Clear."

- d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification-appliance circuits of fire-alarm control unit.
2. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.
3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.
- I. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, shall be powered by 24-V dc source.
 1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.
- J. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
- K. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.5 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
 1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
 2. Station Reset: Key- or wrench-operated switch.
 3. Indoor Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
 4. Weatherproof Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.6 SYSTEM SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:
 1. Comply with UL 268; operating at 24-V dc, nominal.
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
 3. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
 4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.

5. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
 6. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
 - a. Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
 - b. Fixed-temperature sensing characteristic of combination smoke- and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
 - c. Multiple levels of detection sensitivity for each sensor.
 - d. Sensitivity levels based on time of day.
- B. Photoelectric Smoke Detectors:
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
 2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).
- C. Ionization Smoke Detector:
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
 2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).
- D. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
 2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).

3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

2.7 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.
 1. Temperature sensors shall test for and communicate the sensitivity range of the device.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of **135 deg F (57 deg C)** or a rate of rise that exceeds **15 deg F (8 deg C)** per minute unless otherwise indicated.
 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
- C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of **190 deg F (88 deg C)**.
 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.8 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Individually addressed, connected to a signaling-line circuit, equipped for mounting as indicated, and with screw terminals for system connections.
- B. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.
 1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.
- C. Chimes, Low-Level Output: Vibrating type, 75-dBA minimum rated output.
- D. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.
- E. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured **10 feet (3 m)** from the horn, using the coded signal prescribed in UL 464 test protocol.

- F. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens. White Lens with red lettering
 - 1. Rated Light Output:
 - a. 15/30/75/110 cd, selectable in the field.
 - 2. Mounting: Wall mounted unless otherwise indicated.
 - 3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
 - 4. Flashing shall be in a temporal pattern, synchronized with other units.
 - 5. Strobe Leads: Factory connected to screw terminals.
 - 6. Mounting Faceplate: Factory finished, red .
- G. Voice/Tone Notification Appliances:
 - 1. Comply with UL 1480.
 - 2. Speakers for Voice Notification: Locate speakers for voice notification to provide the intelligibility requirements of the "Notification Appliances" and "Emergency Communications Systems" chapters in NFPA 72.
 - 3. High-Range Units: Rated 2 to 15 W.
 - 4. Low-Range Units: Rated 1 to 2 W.
 - 5. Mounting: Flush semirecessed or surface mounted and bidirectional.
 - 6. Matching Transformers: Tap range matched to acoustical environment of speaker location.

2.9 REMOTE ANNUNCIATOR

- A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
 - 1. Mounting: Flush cabinet, NEMA 250, Type 1.
- B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.10 ADDRESSABLE INTERFACE DEVICE

- A. General:
 - 1. Include address-setting means on the module.
 - 2. Store an internal identifying code for control panel use to identify the module type.
 - 3. Listed for controlling HVAC fan motor controllers.
- B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- C. Control Module:
 - 1. Operate notification devices.
 - 2. Operate solenoids for use in sprinkler service.

3. .

2.11 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.
- B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.
- C. Local functions and display at the digital alarm communicator transmitter shall include the following:
 - 1. Verification that both telephone lines are available.
 - 2. Programming device.
 - 3. LED display.
 - 4. Manual test report function and manual transmission clear indication.
 - 5. Communications failure with the central station or fire-alarm control unit.
 - 6. .
- D. Digital data transmission shall include the following:
 - 1. Address of the alarm-initiating device.
 - 2. Address of the supervisory signal.
 - 3. Address of the trouble-initiating device.
 - 4. Loss of ac supply.
 - 5. Loss of power.
 - 6. Low battery.
 - 7. Abnormal test signal.
 - 8. Communication bus failure.
 - 9. .
- E. Secondary Power: Integral rechargeable battery and automatic charger.
- F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.12 DEVICE GUARDS

- A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
 - 1. Factory fabricated and furnished by device manufacturer.
 - 2. Finish: Paint of color to match the protected device.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
 - 1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
 - 1. Devices placed in service before all other trades have completed cleanup shall be replaced.
 - 2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.
- B. Install wall-mounted equipment, with tops of cabinets not more than **78 inches (1980 mm)** above the finished floor.
 - 1. Comply with requirements for seismic-restraint devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- C. Manual Fire-Alarm Boxes:
 - 1. Install manual fire-alarm box in the normal path of egress within **60 inches (1520 mm)** of the exit doorway.
 - 2. Mount manual fire-alarm box on a background of a contrasting color.
 - 3. The operable part of manual fire-alarm box shall be between **42 inches (1060 mm)** and **48 inches (1220 mm)** above floor level. All devices shall be mounted at the same height unless otherwise indicated.
- D. Smoke- or Heat-Detector Spacing:
 - 1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
 - 2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
 - 3. Smooth ceiling spacing shall not exceed **30 feet (9 m)**.
 - 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A in NFPA 72.

5. HVAC: Locate detectors not closer than **36 inches ((910 mm))** from air-supply diffuser or return-air opening.
 6. Lighting Fixtures: Locate detectors not closer than **12 inches (300 mm)** from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.
- E. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.
 - F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than **36 inches (9100 mm)** long shall be supported at both ends.
 1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.
 - G. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.
 - H. Audible Alarm-Indicating Devices: Install not less than **6 inches (150 mm)** below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.
 - I. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least **6 inches (150 mm)** below the ceiling. Install all devices at the same height unless otherwise indicated.
 - J. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.3 PATHWAYS

- A. Pathways above recessed ceilings and in nonaccessible locations may be routed exposed.
 1. Exposed pathways located less than **96 inches (2440 mm)** above the floor shall be installed in EMT.
- B. Pathways shall be installed in EMT.

3.4 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.
 1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than **36 inches (910 mm)** from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Alarm-initiating connection to smoke-control system (smoke management) at firefighters' smoke-control system panel.
2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
3. Smoke dampers in air ducts of designated HVAC duct systems.
4. Magnetically held-open doors.
5. Electronically locked doors and access gates.
6. Alarm-initiating connection to elevator recall system and components.
7. Alarm-initiating connection to activate emergency lighting control.
8. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
9. Supervisory connections at valve supervisory switches.
10. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
11. Supervisory connections at elevator shunt-trip breaker.
12. Data communication circuits for connection to building management system.
13. Data communication circuits for connection to mass notification system.
14. Supervisory connections at fire-extinguisher locations.
15. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
16. Supervisory connections at fire-pump engine control panel.
17. .

3.5 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

3.6 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.
- B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.7 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by authorities having jurisdiction .
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
- D. Perform the following tests and inspections:
 1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.

- b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
 - 2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - 3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
 - 4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
 - 5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
 - 6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
- E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
 - F. Fire-alarm system will be considered defective if it does not pass tests and inspections.
 - G. Prepare test and inspection reports.
 - H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
 - I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.8 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - 2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - 3. Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.9 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

- C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
 - 1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

3.10 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION

SECTION 31 1000 - SITE CLEARING

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. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Stripping and stockpiling rock.
6. Removing above- and below-grade site improvements.
7. Disconnecting, capping or sealing, and removing site utilities.
8. Temporary erosion and sedimentation control.

B. Related Requirements:

1. Section 01 5000 "Temporary Facilities and Controls" for temporary erosion- and sedimentation-control measures.

C. Related Requirements:

1. Section 01500 "Temporary Facilities and Controls" for temporary erosion- and sedimentation-control measures.

1.3 DEFINITIONS

- A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects larger than 2 inches in diameter; and free of weeds, roots, toxic materials, or other non-soil materials.

- D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.
- E. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings.
- F. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

- A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 INFORMATIONAL SUBMITTALS

- A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
 - 1. Use sufficiently detailed photographs or video recordings.
 - 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.
- B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 FIELD 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 trafficways if required by Owner or authorities having jurisdiction.
- B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
 - 1. Do not proceed with work on adjoining property until directed by the Owner.
- C. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
 - 1. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.:
 - a. Blue Stakes of Utah, 148 East 13200 South, Draper Utah 84020
 - 1) Phone numbers:
 - a) 811

- b) 800-662-4111
- c) 801-208-2100
- 2) Hours: Verify all times and days.
 - a) Monday 7am – 5pm
 - b) Tuesday 7am – 5pm
 - c) Wednesday 7am – 5pm
 - d) Thursday 7am – 5pm
 - e) Friday 7am – 5pm
 - f) Saturday CLOSED
 - g) Sunday CLOSED

- D. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.
- E. Tree- and Plant-Protection Zones: Protect according to requirements in Section 01 5639 "Temporary Tree and Plant Protection."
- F. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 31 2000 "Earth Moving."
 - 1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed according to requirements in Section 01 5639 "Temporary Tree and Plant Protection."
- C. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 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 erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.
- B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

- A. Protect trees and plants remaining on-site according to requirements in Section 01 5639 "Temporary Tree and Plant Protection."
- B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations according to requirements in Section 01 5639 "Temporary Tree and Plant Protection."

3.4 EXISTING UTILITIES

- A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed.
 - 1. Arrange with utility companies to shut off indicated utilities.
- B. Locate, identify, and disconnect utilities indicated to be abandoned in place.
- C. Interrupting 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 Owner not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Architect's written permission.
- D. Excavate for and remove underground utilities indicated to be removed.
- E. Removal of underground utilities is included in earthwork sections; in applicable fire suppression, plumbing, HVAC, electrical, communications, electronic safety and security, and utilities sections; and in Section 02 4116 "Structure Demolition" and Section 02 4119 "Selective Demolition."

3.5 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, 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. Grind down stumps and remove roots larger than 2 inches in diameter, obstructions, and debris to a depth of 18 inches below exposed subgrade.
 - 3. Use only hand methods or air spade for grubbing within protection zones.
 - 4. Chip removed tree branches and dispose of off-site.
- 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 and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to depth of 6 inches in a manner to prevent intermingling with underlying subsoil or other waste materials.
 - 1. Remove subsoil and non-soil materials from topsoil, including clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
 - 1. Limit height of topsoil stockpiles to 72 inches.
 - 2. Do not stockpile topsoil within protection zones.
 - 3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
 - 4. Stockpile surplus topsoil to allow for re-spreading deeper topsoil.

3.7 STOCKPILING ROCK

- A. Remove from construction area naturally formed rocks that measure more than 1 foot across in least dimension. Do not include excavated or crushed rock.
 - 1. Separate or wash off non-rock materials from rocks, including soil, clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.
- B. Stockpile rock away from edge of excavations without intermixing with other materials. Cover to prevent windblown debris from accumulating among rocks.

1. Limit height of rock stockpiles to 36 inches.
2. Do not stockpile rock within protection zones.
3. Dispose of surplus rock. Surplus rock is that which exceeds quantity indicated to be stockpiled or reused.
4. Stockpile surplus rock to allow later use by the Owner.

3.8 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and 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 along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
 2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. 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.
- B. 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. Do not interfere with other Project work.

END OF SECTION 31 1000

SECTION 31 2000 - EARTH MOVING

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. Excavating and filling for rough grading the Site.
2. Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses, and plants.
3. Excavating and backfilling for buildings and structures.
4. Drainage course for concrete slabs-on-grade.
5. Subbase course for concrete walks and pavements.
6. Subbase course and base course for asphalt paving.
7. Subsurface drainage backfill for walls and trenches.
8. Excavating and backfilling trenches for utilities and pits for buried utility structures.

B. Related Requirements:

1. Section 01 3200 "Construction Progress Documentation" for recording pre-excavation and earth-moving progress.
2. Section 03 3000 "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
3. Section 31 1000 "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
4. Section 31 5000 "Excavation Support and Protection" for shoring, bracing, and sheet piling of excavations.
5. Section 32 9200 "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.
6. Section 32 9300 "Plants" for finish grading in planting areas and tree and shrub pit excavation and planting.

1.3 UNIT PRICES

- A. Work of this Section is affected by unit prices for earth moving specified in Section 01 2200 "Unit Prices."

1.4 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 Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.
- C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. 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 Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
 2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
 3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.
- G. Fill: Soil materials used to raise existing grades.
- H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. for bulk excavation or 3/4 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock-excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
1. Equipment for Footing, Trench, and Pit Excavation: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch-maximum-width, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,700 lbf and stick-crowd force of not less than 18,400 lbf with extra-long reach boom.
- I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- J. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- K. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

- L. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:
 - 1. Classification according to ASTM D 2487.
 - 2. Laboratory compaction curve according to ASTM D 698.
- C. Seismic survey report from seismic survey agency.
- D. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth-moving operations. Submit before earth moving begins.

1.6 QUALITY ASSURANCE

- A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

1.7 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving 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 Owner or authorities having jurisdiction.
- B. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
 - 1. Do not proceed with work on adjoining property until directed by Owner.
 - 2. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.:
 - a. Blue Stakes of Utah, 148 East 13200 South, Draper Utah 84020
 - 1) Phone numbers:
 - a) 811
 - b) 800-662-4111
 - c) 801-208-2100
 - b. Hours: Verify all times and days.
 - 1) Monday 7am – 5pm
 - 2) Tuesday 7am – 5pm

3)	Wednesday	7am – 5pm
4)	Thursday	7am – 5pm
5)	Friday	7am – 5pm
6)	Saturday	CLOSED
7)	Sunday	CLOSED

- C. Do not commence earth-moving operations until plant-protection measures specified in Section 01 5639 "Temporary Tree and Plant Protection" are in place.
- D. The following practices are prohibited within protection zones:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Parking vehicles or equipment.
 - 3. Foot traffic.
 - 4. Erection of sheds or structures.
 - 5. Impoundment of water.
 - 6. Excavation or other digging unless otherwise indicated.
 - 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- E. Do not direct vehicle or equipment exhaust towards protection zones.
- F. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

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: Soil Classification: As directed by Geotechnical Engineer for the project for the intended use and placement.
- C. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- D. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 294/D 2940M 0; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.
- E. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

- F. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
- G. Drainage Course: Narrowly graded mixture of crushed stone or, crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and zero to 5 percent passing a No. 8 sieve.
- H. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and zero to 5 percent passing a No. 4 sieve.
- I. Sand: ASTM C 33/C 33M; fine aggregate.
- J. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES

- A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
- B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

2.3 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored as follows:
 - 1. Red: Electric.
 - 2. Yellow: Gas, oil, steam, and dangerous materials.
 - 3. Orange: Telephone and other communications.
 - 4. Blue: Water systems.
 - 5. Green: Sewer systems.
- B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
 - 1. Red: Electric.
 - 2. Yellow: Gas, oil, steam, and dangerous materials.
 - 3. Orange: Telephone and other communications.
 - 4. Blue: Water systems.

5. Green: Sewer systems.

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 earth-moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth-moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

- A. Provide dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.
- B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- C. 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.
- D. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

3.3 EXPLOSIVES

- A. Explosives: Do not use explosives.

3.4 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.
2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
 - B. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by Architect. The Contract Sum will be adjusted for rock excavation according to unit prices included in the Contract Documents. Changes in the Contract Time may be authorized for rock excavation.
 1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; and soil, boulders, and other materials not classified as rock or unauthorized excavation.
 - a. Intermittent drilling; blasting, if permitted; ram hammering; or ripping of material not classified as rock excavation is earth excavation.

3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing engineered fill. Trim bottoms to required lines and grades to leave solid base to receive other work.
 2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- 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 higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: 12 inches each side of pipe or conduit or as otherwise indicated.
- C. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.
1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
- D. Trenches in Tree- and Plant-Protection Zones:
1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
 2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
 3. Cut and protect roots according to requirements in Section 01 5639 "Temporary Tree and Plant Protection."

3.8 SUBGRADE INSPECTION

- A. Notify Architect when excavations have reached required subgrade.
- B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
- D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Architect.
 1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.10 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.

3.11 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 1. Construction below finish grade including, where applicable, subdrainage, damp-proofing, 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, bracing, and sheeting.
 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 03 3000 "Cast-in-Place Concrete."
- D. Trenches under Roadways: Provide 4-inch- thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase course. Concrete is specified in Section 03 3000 "Cast-in-Place Concrete."
- E. Backfill voids with satisfactory soil while removing shoring and bracing.
- F. Initial Backfill:
 1. Soil Backfill: Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.
 - a. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

- G. Final Backfill:
 - 1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.
- H. Warning Tape: Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.13 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.
 - 3. Under steps and ramps, use engineered fill.
 - 4. Under building slabs, use engineered fill.
 - 5. Under footings and foundations, use engineered fill.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.14 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.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
 - 1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at the requirements of the Geotechnical Engineering Report.
 - 2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at the requirements of the Geotechnical Engineering Report.

3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at the requirements of the Geotechnical Engineering Report.
4. For utility trenches, compact each layer of initial and final backfill soil material the requirements of the Geotechnical Engineering Report.

3.16 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.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:
 1. Turf or Unpaved Areas: Plus or minus 1 inch.
 2. Walks: Plus or minus 1 inch.
 3. Pavements: Plus or minus 1/2 inch.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.17 SUBSURFACE DRAINAGE

- A. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches of filter material, placed in compacted layers 6 inches thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
 1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698.
- B. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
 1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698.
 2. Place and compact impervious fill over drainage backfill in 6-inch-thick compacted layers to final subgrade as per the requirements of the Geotechnical Engineering Report.

3.18 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:
 - 1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 - 2. Place base course material over subbase course under hot-mix asphalt pavement.
 - 3. Shape subbase course and base course to required crown elevations and cross-slope grades.
 - 4. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698, ASTM D 1557, and the requirements of the Geotechnical Engineering Report.
- C. Pavement Shoulders: Place shoulders along edges of subbase course and base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 95 percent of maximum dry unit weight according to ASTM D 698, ASTM D 1557, and the requirements of the Geotechnical Engineering Report..

3.19 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
 - 1. Place drainage course 6 inches or less in compacted thickness in a single layer.
 - 2. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.20 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

- D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2937, and ASTM D 6938, as applicable. Tests will be performed at the following locations and frequencies:
- E. 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 materials to depth required; recompact and retest until specified compaction is obtained.

3.21 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 Architect; 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.

3.22 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.
 - 1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 31 2000

SECTION 31 2319 - DEWATERING

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 construction dewatering.
- B. Related Requirements:
 - 1. Section 01 3233 "Photographic Documentation" for recording preexisting conditions and dewatering system progress.
 - 2. Section 31 2000 "Earth Moving" for excavating, backfilling, site grading, and controlling surface-water runoff and ponding.

1.3 ALLOWANCES

- A. Dewatering observation wells are part of dewatering allowance.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Verify availability of Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Review condition of site to be dewatered including coordination with temporary erosion-control measures and temporary controls and protections.
 - 3. Review geotechnical report.
 - 4. Review proposed site clearing and excavations.
 - 5. Review existing utilities and subsurface conditions.
 - 6. Review observation and monitoring of dewatering system.

1.5 ACTION SUBMITTALS

- A. Shop Drawings: For dewatering 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 wells and well points; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, and disposal of water.

3. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
4. Include written plan for dewatering operations including sequence of well and well-point placement coordinated with excavation shoring and bracings and control procedures to be adopted if dewatering problems arise.

1.6 INFORMATIONAL SUBMITTALS

- A. Existing Conditions: Using photographs, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by dewatering operations. Submit before Work begins.
- B. Record Drawings: Identify locations and depths of capped wells and well points and other abandoned-in-place dewatering equipment.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer that has specialized in design of dewatering systems and dewatering work.

1.8 FIELD CONDITIONS

- A. 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 this data.
 1. Make additional test borings and conduct other exploratory operations necessary for dewatering according to the performance requirements.
 2. The geotechnical report is included elsewhere in Project Manual.
- B. 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. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.
 1. Design dewatering system, including comprehensive engineering analysis by a qualified professional engineer.

2. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, prevention of flooding in excavation, and prevention of damage to subgrades and permanent structures.
 3. Prevent surface water from entering excavations by grading, dikes, or other means.
 4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
 5. Remove dewatering system when no longer required for construction.
- B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning dewatering. Comply with water- and debris-disposal regulations of authorities having jurisdiction.

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 dewatering operations.
1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site or surrounding area.
 2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
- B. Install dewatering system 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. Provide temporary grading to facilitate dewatering and control of surface water.
- D. Protect and maintain temporary erosion and sedimentation controls, which are specified in Section 01 5000 "Temporary Facilities and Controls," and Section 31 1000 "Site Clearing," during dewatering operations.

3.2 INSTALLATION

- A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.
1. Space well points or wells at intervals required to provide sufficient dewatering.
 2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.

- B. Place dewatering system into operation to lower water to specified levels before excavating below ground-water level.
- C. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.
- D. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails.

3.3 OPERATION

- A. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.
- B. Operate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.
 - 1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
 - 2. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
 - 3. Maintain piezometric water level a minimum of 24 inches below bottom of excavation.
- C. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.
- D. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.

3.4 FIELD QUALITY CONTROL

- A. Observation Wells: Provide observation wells or piezometers, take measurements, and maintain at least the minimum number indicated; additional observation wells may be required by authorities having jurisdiction.
 - 1. Observe and record daily elevation of ground water and piezometric water levels in observation wells.
 - 2. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. In areas where observation wells are not functioning properly, suspend construction activities until reliable observations can be made. Add or remove water from observation-well risers to demonstrate that observation wells are functioning properly.
 - 3. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.

- B. Survey-Work Benchmarks: Resurvey benchmarks regularly during dewatering and maintain an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Architect if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.
- C. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation.
- D. Prepare reports of observations.

3.5 PROTECTION

- A. Protect and maintain dewatering system during dewatering operations.
- B. Promptly repair damages to adjacent facilities caused by dewatering.

END OF SECTION 31 2319

SECTION 31 2500 - EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes Temporary erosion and sedimentation control measures.
- B. Related Requirements:
 - 1. Division 00 Section "Geotechnical Data". Coordinate requirements of this Section with those of the Geotechnical Data. If a discrepancy exists between the requirements found in this Section and those found in the geotechnical investigation report the requirements of the report governs.

1.3 QUALITY ASSURANCE

- A. Preinstallation Conference: Conduct conference at Project Site as specified by the Storm Water Pollution Prevention Plan (SWPPP) with applicable subcontractors, the civil engineer of record, the Owner's Representative, and any applicable governing officials.

1.4 PROJECT CONDITIONS

- A. Review and certify the SWPPP with the Owner prior to beginning onsite work.
- B. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied facilities when installing erosion controls. Coordinate all measures with applicable government authorities having jurisdiction over the connecting, adjacent, or surrounding roadways.
- C. Utility Locator Service: Notify utility locator service for area where Project is located before installing erosion or sediment control measures.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Erosion/Sediment control devices or Best Management Practices as indicated in the SWPPP.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordination with the Owner to provide for the requirements of the SWPPP and associated permits.

3.2 IMPLEMENTATION AND DOCUMENTATION

- A. Inspect, repair, and maintain erosion and sedimentation control measures, per the SWPPP, during construction until permanent vegetation has been established.
- B. Execute required site inspection checklists, documents, and site logs in the SWPPP.
- C. Update, maintain, alter, or add temporary erosion and sediment controls in conjunction with the SWPPP and ongoing earthwork activities as required for the Project.
- D. Maintain an up-to-date Site Plan in the field office. Continually update the Site Plan with notations that coordinate with the site checklists and logs per the SWPPP.
- E. The Owner's Representative has the right and authority to limit earth-moving activities and to direct the Contractor to immediately provide permanent or temporary pollution control measures.
- F. Install permanent erosion measures such as pavement and lawn areas as soon as practically possible to minimize temporary pollution control measures.
- G. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- H. Ensure that a proper Notice of Termination (NOT) is filed with the governing authority

3.3 CLOSEOUT DOCUMENTS

- A. Before retainage can be released, the Contractor must provide the Owner with a final copy of all documents making up the SWPPP including plans, checklists, and logs.
 - 1. Retain a copy of the above documentation for a minimum of three years from final acceptance.

END OF SECTION 31 2500

SECTION 31 5000 - 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 31 2000 "Earth Moving" for excavating and backfilling, for controlling surface-water runoff and ponding, and for dewatering excavations.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation 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. Delegated-Design Submittal: For excavation support and protection systems, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For the following:

1. Land surveyor.
 2. Professional Engineer: Experience with providing delegated-design engineering services of the type indicated, including documentation that engineer is licensed in the jurisdiction and state in which Project is located.
- B. Contractor Calculations: For excavation support and protection system. Include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Existing Conditions: Using photographs or video recordings, 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.

1.6 CLOSEOUT SUBMITTALS

- A. Record Drawings: Identify locations and depths of capped utilities, abandoned-in-place support and protection systems, and other subsurface structural, electrical, or mechanical conditions.

1.7 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. 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. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design excavation support and protection systems to resist all lateral loading and surcharge, including but not limited to, retained soil, groundwater pressure, adjacent building loads, adjacent traffic loads, construction traffic loads, material stockpile loads, and seismic loads, based on the following:
1. Compliance with OSHA Standards and interpretations, 29 CFR 1926, Subpart P.
 2. Compliance with AASHTO Standard Specification for Highway Bridges or AASHTO LRFD Bridge Design Specification, Customary U.S. Units.
 3. Compliance with requirements of authorities having jurisdiction.

4. Compliance with utility company requirements.
5. Compliance with railroad requirements.

2.2 MATERIALS

- A. 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.
- D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of size and strength required for application.
- E. Shotcrete: Comply with Section 03 3713 "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.

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.

3.2 INSTALLATION - GENERAL

- A. Locate excavation support and protection systems clear of permanent construction, so that construction and finishing of other work is not impeded.
- 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.
 2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.

3.3 SOLDIER PILES AND LAGGING

- A. Install steel soldier piles before starting excavation.
 - 1. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement.
 - 2. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging.
 - 3. 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.
 - 1. Trim excavation as required to install lagging.
 - 2. Fill voids behind lagging with soil, and compact.
- C. Install wales horizontally at locations indicated on Drawings and secure to soldier piles.

3.4 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.
 - 1. Limit vertical offset of adjacent sheet piling to 60 inches.
 - 2. 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.

3.5 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.

3.6 BRACING

- A. Locate bracing to clear columns, floor framing construction, and other permanent work. If it is 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.

3.7 MAINTENANCE

- A. Monitor and maintain excavation support and protection system.
- B. Prevent surface water from entering excavations by grading, dikes, or other means.
- C. Continuously monitor vibrations, settlements, and movements to ensure stability of excavations and constructed slopes and to ensure that damage to permanent structures is prevented.

3.8 FIELD QUALITY CONTROL

- A. Survey-Work Benchmarks: Resurvey benchmarks regularly during installation of excavation support and protection systems, excavation progress, and for as long as excavation remains open.
 1. Maintain an accurate log of surveyed elevations and positions for comparison with original elevations and positions.
 2. 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.

3.9 REMOVAL AND REPAIRS

- A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and earth and hydrostatic pressures.
 1. Remove in stages to avoid disturbing underlying soils and rock or damaging structures, pavements, facilities, and utilities.
 2. Fill voids immediately with approved backfill compacted to density specified in Section 31 2000 "Earth Moving."
 3. Repair or replace, as approved by Architect, adjacent work damaged or displaced by removing excavation support and protection systems.

END OF SECTION 31 5000

SECTION 32 1216 - ASPHALT PAVING

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. Cold milling of existing asphalt pavement.
 - 2. Hot-mix asphalt patching.
 - 3. Hot-mix asphalt paving.
 - 4. Hot-mix asphalt overlay.
- B. Related Requirements:
 - 1. Section 02 4119 "Selective Demolition" for demolition and removal of existing asphalt pavement.
 - 2. Section 31 2000 "Earth Moving" for subgrade preparation, fill material, separation geotextiles, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.
 - 3. Section 32 1313 "Concrete Paving" for concrete pavement and for separate concrete curbs, gutters, and driveway aprons.
 - 4. Section 32 1373 "Concrete Paving Joint Sealants" for joint sealants and fillers at pavement terminations.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:
 - a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
 - b. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Material Certificates: For each paving material.
- C. Material Test Reports: For each paving material, by a qualified testing agency.
- D. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or the DOT of state in which Project is located.
- B. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of local city engineering department and appropriate Department of Transportation if required for asphalt paving work.
 - 1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
 - 1. Prime Coat: Minimum surface temperature of 60 deg F.
 - 2. Tack Coat: Minimum surface temperature of 60 deg F.
 - 3. Slurry Coat: Comply with weather limitations in ASTM D 3910.
 - 4. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
 - 5. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

- A. General: Use materials and gradations that have performed satisfactorily in previous installations.
- B. Coarse Aggregate: ASTM D 692/D 692M, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.
- C. Fine Aggregate: ASTM D 1073 or AASHTO M 29, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.
 - 1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.
- D. Mineral Filler: ASTM D 242/D 242M or AASHTO M 17, rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

- A. Asphalt Binder: AASHTO M 320 or AASHTO MP 1a, AC10 - for on-site pavement. Coordinate with authority having jurisdiction for pavement in public right-of-ways.
- B. Tack Coat: ASTM D 977 or AASHTO M 140 emulsified asphalt.

- C. Water: Potable.
- D. Undersealing Asphalt: ASTM D 3141/D 3141M; pumping consistency.

2.3 AUXILIARY MATERIALS

- A. Herbicide: Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Provide in granular, liquid or wettable powder form.
- B. Sand: ASTM D 1073 or AASHTO M 29, Grade No. 2 or No. 3.
- C. Joint Sealant: ASTM D 6690, Type II or III, hot-applied, single-component, polymer-modified bituminous sealant.

2.4 MIXES

- A. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and complying with the following requirements:
 - 1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
 - 2. Base Course: 3/4inch.
 - 3. Surface Course: 1/2inch Mix.
- B. Emulsified-Asphalt Slurry: ASTM D 3910, Type 1.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to begin paving.
- B. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protection: Provide protective materials, procedures, and worker training to prevent asphalt materials from spilling, coating, or building up on curbs, driveway aprons, manholes, and other surfaces adjacent to the Work.
- B. 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.
 - 1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph.
 - 2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.

3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

3.3 COLD MILLING

- A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.
 1. Mill to a depth of 2 inches.
 2. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges.
 3. Control rate of milling to prevent tearing of existing asphalt course.
 4. Repair or replace curbs, driveway aprons, manholes, and other construction damaged during cold milling.
 5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
 6. Patch surface depressions deeper than 1 inch after milling, before wearing course is laid.
 7. Keep milled pavement surface free of loose material and dust.
 8. Do not allow milled materials to accumulate on-site.

3.4 PATCHING

- A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.
- B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.
 1. Undersealing: Pump hot undersealing asphalt under rocking slab until slab is stabilized or, if necessary, crack slab into pieces and roll to reseat pieces firmly.
 2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.
- C. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of 0.05 to 0.15 gal./sq. yd..
 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- D. Placing Patch Material: Fill excavated pavement areas with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

3.5 REPAIRS

- A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.
 - 1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.
- B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch.
 - 1. Clean cracks and joints in existing hot-mix asphalt pavement.
 - 2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.
 - 3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3.6 SURFACE PREPARATION

- A. Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
- B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.
 - 1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.
- C. Emulsified Asphalt Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.10 to 0.30 gal./sq. yd. per inch depth. Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.
 - 1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
 - 2. Protect primed substrate from damage until ready to receive paving.
- D. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.
 - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.7 PLACING HOT-MIX ASPHALT

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
 - 1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
 - 2. Place hot-mix asphalt surface course in single lift.
 - 3. Spread mix at a minimum temperature of 250 deg F.

4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
 5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches from strip to strip to ensure proper compaction of mix along longitudinal joints.
 2. Complete a section of asphalt base course before placing asphalt surface course.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.8 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
1. Clean contact surfaces and apply tack coat to joints.
 2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
 3. Offset transverse joints, in successive courses, a minimum of 24 inches.
 4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."
 5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
 6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.9 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
1. Complete compaction before mix temperature cools to 185 deg F.
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 96 percent of reference laboratory density according to ASTM D 6927 or AASHTO T 245, but not less than 94 percent or greater than 100 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.10 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
 1. Base Course: Plus or minus 1/2 inch.
 2. Surface Course: Plus 1/4 inch, no minus.
- B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
 1. Base Course: 1/4 inch.
 2. Surface Course: 1/8 inch.
 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.11 SURFACE TREATMENTS

- A. Slurry Seals: Apply slurry coat in a uniform thickness according to ASTM D 3910 and allow to cure.
 1. Roll slurry seal to remove ridges and provide a uniform, smooth surface.

3.12 FIELD QUALITY CONTROL

- A. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549/D 3549M.
- B. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

- C. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979/D 979M or AASHTO T 168.
 - 1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041/D 2041M, and compacted according to job-mix specifications.
 - 2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726/D 2726M.
 - a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than three cores taken.
 - b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726/D 2726M.
- D. Replace and compact hot-mix asphalt where core tests were taken.
- E. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

END OF SECTION 32 1216

SECTION 32 1313 - CONCRETE PAVING

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 Concrete Paving Including the Following:

- 1. Driveways.
- 2. Roadways.
- 3. Curbs and gutters.
- 4. Walks.

- B. Related Requirements:

- 1. Section 03 3000 "Cast-in-Place Concrete" for general building applications of concrete.
- 2. Section 32 1723 "Pavement Markings."
- 3. Section 32 1726 "Tactile Warning Surfacing" for detectable warning tiles mats and pavers.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

- 1. Review methods and procedures related to concrete paving, including but not limited to, the following:
 - a. Concrete mixture design.
 - b. Quality control of concrete materials and concrete paving construction practices.
- 2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:

- a. Contractor's superintendent.
- b. Independent testing agency responsible for concrete design mixtures.
- c. Ready-mix concrete manufacturer.
- d. Concrete paving Subcontractor.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.6 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For the following, from manufacturer:
 1. Cementitious materials.
 2. Steel reinforcement and reinforcement accessories.
 3. Fiber reinforcement.
 4. Admixtures.
 5. Curing compounds.
 6. Applied finish materials.
 7. Bonding agent or epoxy adhesive.
 8. Joint fillers.

1.7 FIELD CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
 1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 2. Do not use frozen materials or materials containing ice or snow.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.
- C. Hot-Weather Concrete Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
 1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total

- amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

2.2 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
 1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

- A. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, fabricated from as-drawn steel wire into flat sheets.
- B. Deformed-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, flat sheet.
- C. Epoxy-Coated Welded-Wire Reinforcement: ASTM A 884/A 884M, Class A, plain steel.
- D. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.
- E. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615/A 615M, Grade 60 deformed bars.
- F. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 deformed bars.
- G. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60 deformed bars; assembled with clips.
- H. Plain-Steel Wire: ASTM A 1064/A 1064M, as drawn.
- I. Deformed-Steel Wire: ASTM A 1064/A 1064M.

- J. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 plain-steel bars; zinc coated (galvanized) after fabrication according to ASTM A 767/A 767M, Class I coating. Cut bars true to length with ends square and free of burrs.
- K. Tie Bars: ASTM A 615/A 615M, Grade 60; deformed.
- L. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
- M. 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 specified, and as follows:
 - 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
- N. Zinc Repair Material: ASTM A 780/A 780M.

2.4 CONCRETE MATERIALS

- A. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:
 - 1. Portland Cement: ASTM C 150/C 150M, gray portland cement Type I/II.
 - 2. Fly Ash: ASTM C 618, Class C or Class F.
 - 3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33/C 33M, Class 4S, uniformly graded. Provide aggregates from a single source.
 - 1. Maximum Coarse-Aggregate Size: 1 inch nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Air-Entraining Admixture: ASTM C 260/C 260M.
- D. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
- E. Water: Potable and complying with ASTM C 94/C 94M.

2.5 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 3, 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.
- D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

2.6 RELATED MATERIALS

- A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork in preformed strips.
- B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.
- C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy-Bonding Adhesive: ASTM C 881/C 881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:
 - 1. Types I and II, nonload bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.7 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
 - 2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that comply with or exceed requirements.
- B. Cementitious Materials: Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
- 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: 5-1/2 percent plus or minus 1-1/2 percent for 1-1/2-inch nominal maximum aggregate size.
 - 2. Air Content: 6 percent plus or minus 1-1/2 percent for 1-inch nominal maximum aggregate size.

3. Air Content: 6 percent plus or minus 1-1/2 percent for 3/4-inch nominal maximum aggregate size.
- D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
- F. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd..
- G. Concrete Mixtures: Normal-weight concrete.
 1. Compressive Strength (28 Days): 4000 psi.
 2. Maximum W/C Ratio at Point of Placement: 0.45.
 3. Slump Limit: 4 inches, plus or minus 1 inch.

2.8 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.
 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 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 paving to identify soft pockets and areas of excess yielding.
 1. Completely proof-roll subbase in one direction. Limit vehicle speed to 3 mph.
 2. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Section 31 2000 "Earth Moving."
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

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 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 INSTALLATION

- 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.
- D. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.
- F. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges 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 paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
 - 1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
 - 2. Provide tie bars at sides of paving strips where indicated.
 - 3. Butt Joints: Use bonding agent 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. Lubricate or coat with asphalt 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, other fixed objects, and where indicated.
1. Locate expansion joints at intervals of 50 feet unless otherwise indicated.
 2. Extend joint fillers full width and depth of joint.
 3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 6. During concrete placement, protect top edge of joint filler 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 paving:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.
 - a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.
 2. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.
- B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

- D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.
- H. Screed paving surface with a straightedge and strike off.
- I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.
- K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.
 - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

3.7 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
 - 1. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.

3.8 DETECTABLE WARNING INSTALLATION

- A. Blockouts: Form blockouts in concrete for installation of detectable paving units specified in Section 32 1726 "Tactile Warning Surfacing."

1. Tolerance for Opening Size: Plus 1/4 inch, no minus.
- B. Cast-in-Place Detectable Warning Tiles: Form blockouts in concrete for installation of tiles specified in Section 32 1726 "Tactile Warning Surfacing." Screed surface of concrete where tiles are to be installed to elevation, so that edges of installed tiles will be flush with surrounding concrete paving. Embed tiles in fresh concrete to comply with Section 32 1726 "Tactile Warning Surfacing" immediately after screeding concrete surface.
- C. Stamped Detectable Warnings: Install stamped detectable warnings as part of a continuous concrete paving placement and according to stamp-mat manufacturer's written instructions.
 1. Before using stamp mats, verify that the vent holes are unobstructed.
 2. Apply liquid release agent to the concrete surface and the stamp mat.
 3. Stamping: While initially finished concrete is plastic, accurately align and place stamp mats in sequence. Uniformly load, gently vibrate, and press mats into concrete to produce imprint pattern on concrete surface. Load and tamp mats directly perpendicular to the stamp-mat surface to prevent distortion in shape of domes. Press and tamp until mortar begins to come through all of the vent holes. Gently remove stamp mats.
 4. Trimming: After 24 hours, cut off the tips of mortar formed by the vent holes.
 5. Remove residual release agent according to manufacturer's written instructions, but no fewer than three days after stamping concrete. High-pressure-wash surface and joint patterns, taking care not to damage stamped concrete. Control, collect, and legally dispose of runoff.

3.9 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture-retaining-cover curing or a combination of these as follows:
 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.

- c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period, using cover material and waterproof tape.

3.10 PAVING TOLERANCES

- A. Comply with tolerances in ACI 117 and as follows:
 1. Elevation: 3/4 inch.
 2. Thickness: Plus 3/8 inch, minus 1/4 inch.
 3. Surface: Gap below 10-foot-long; unlevelled straightedge not to exceed 1/2 inch.
 4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
 5. Lateral Alignment and Spacing of Dowels: 1 inch.
 6. Vertical Alignment of Dowels: 1/4 inch.
 7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
 8. Joint Spacing: 3 inches.
 9. Contraction Joint Depth: Plus 1/4 inch, no minus.
 10. Joint Width: Plus 1/8 inch, no minus.

3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- C. Test results shall be reported in writing to Architect, 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.
- D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- E. 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 Architect.

- F. Concrete paving will be considered defective if it does not pass tests and inspections.
- G. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- H. Prepare test and inspection reports.

3.12 REPAIR AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
- B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 32 1313

SECTION 32 1373 - CONCRETE PAVING JOINT SEALANT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Expansion and contraction joints within portland cement concrete pavement.
 - 2. Joints between portland cement concrete and asphalt pavement.
- B. Related Sections include the following:
 - 1. Division 32 Section "Asphaltic Concrete Paving" for constructing joints between concrete and asphalt pavement.
 - 2. Division 32 Section "Portland Cement Concrete Pavement" for constructing joints in concrete paving.
 - 3. Division 7 Section "Joint Sealants" for sealing nontraffic and traffic joints in locations not specified in this Section.

1.3 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Verification: For each type and color of joint sealant required. Install joint-sealant samples in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- C. Product Certificates: Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.
- D. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

- E. Compatibility and Adhesion Test Reports: From joint sealant manufacturer indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backer materials have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- F. Product Test Reports: From a qualified testing agency indicating joint sealants comply with requirements, based on comprehensive testing of current product formulations.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- C. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency, based on testing current sealant formulations within a 36-month period.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.
 - 2. Test joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.
- D. Preconstruction Compatibility and Adhesion Testing: Submit to joint sealant manufacturer, for testing indicated below, samples of materials that will contact or affect joint sealants.
 - 1. Use manufacturer's standard test methods to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - a. Perform tests under environmental conditions replicating those that will exist during installation.
 - 2. Submit not fewer than nine pieces of each type of material, including joint substrates, joint-sealant backer materials, secondary seals, and miscellaneous material.
 - 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.

4. For materials failing tests, obtain joint sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.
5. Testing will not be required if joint sealant manufacturer submits joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

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. Environmental Limitations: Do not proceed with installation of joint sealants under the following conditions:
 1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer.
 2. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 deg F.
 3. When joint substrates are wet.
- B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than that allowed by joint sealant manufacturer for application indicated.
- C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are 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.
- B. Colors of Exposed Joint Sealants: Match Architect's samples.

- C. Colors of Exposed Joint Sealants: As indicated by referencing manufacturer's designations.
- D. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range for this characteristic.

2.2 COLD-APPLIED JOINT SEALANTS

- A. Multicomponent Jet-Fuel-Resistant Sealant for Concrete: Pourable, chemically curing elastomeric formulation complying with the following requirements for formulation and with ASTM C 920 for type, grade, class, and uses indicated:
 - 1. Urethane Formulation: Type M; Grade P; Class 12-1/2; Uses T, M, and, as applicable to joint substrates indicated, O.
 - 2. Coal-Tar-Modified Polymer Formulation: Type M; Grade P; Class 25; Uses T and, as applicable to joint substrates indicated, O.
 - 3. Bitumen-Modified Urethane Formulation: Type M; Grade P; Class 25; Uses T, M, and, as applicable to joint substrates indicated, O.
- B. Single-Component Jet-Fuel-Resistant Urethane Sealant for Concrete: Single-component, pourable, coal-tar-modified, urethane formulation complying with ASTM C 920 for Type S; Grade P; Class 25; Uses T, M, and, as applicable to joint substrates indicated, O.
- C. Type NS Silicone Sealant for Concrete: Single-component, low-modulus, neutral-curing, nonsag silicone sealant complying with ASTM D 5893 for Type NS.
- D. 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.
- E. Multicomponent Low-Modulus Sealant for Concrete and Asphalt: Proprietary formulation consisting of reactive petropolymer and activator components producing a pourable, self-leveling sealant.
- F. Available Products: Subject to compliance with requirements, cold-applied joint sealants that may be incorporated into the Work include, but are not limited to, the following:
- G. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Multicomponent Jet-Fuel-Resistant Sealant for Concrete:
 - a. Vulkem 202; Mameco International.
 - b. SEALTIGHT GARDOX; W.R. Meadows, Inc.
 - c. Urexpan NR-300; Pecora Corporation.
 - d. Sonomeric 2; Sonneborn Building Products Div., ChemRex, Inc.

2. Single-Component Jet-Fuel-Resistant Urethane Sealant for Concrete:
 - a. Vulkem 200; Mameco International.
 - b. Sonomeric 1; Sonneborn Building Products Div., ChemRex, Inc.
3. Type NS Silicone Sealant for Concrete:
 - a. Roadsaver Silicone-SL; Crafcoc Inc.
 - b. 888; Dow Corning.
4. Type SL Silicone Sealant for Concrete and Asphalt:
 - a. 890-SL; Dow Corning.
5. Multicomponent Low-Modulus Sealant for Concrete and Asphalt:
 - a. SOF-SEAL; W.R. Meadows, Inc.

2.3 HOT-APPLIED JOINT SEALANTS

- A. Jet-Fuel-Resistant Elastomeric Sealant for Concrete: Single-component formulation complying with ASTM D 3569.
- B. Jet-Fuel-Resistant Sealant for Concrete and Tar Concrete: Single-component formulation complying with ASTM D 3581.
- C. Elastomeric Sealant for Concrete: Single-component formulation complying with ASTM D 3406.
- D. Sealant for Concrete and Asphalt: Single-component formulation complying with ASTM D 3405.
- E. Available Products: Subject to compliance with requirements, hot-applied joint sealants that may be incorporated into the Work include, but are not limited to, the following:
- F. Products: Subject to compliance with requirements, provide one of the following:
 1. Jet-Fuel-Resistant Elastomeric Sealant for Concrete:
 - a. Superseal 444/777; Crafcoc, Inc.
 - b. POLY-JET 3569; W.R. Meadows, Inc.
 2. Jet-Fuel-Resistant Sealant for Concrete and Tar Concrete:
 - a. SUPERSEAL 1614A; Crafcoc Inc.
 - b. POLY-JET 1614; W.R. Meadows, Inc.

- c. POLY-JET 3406; W.R. Meadows, Inc.
 - d. POLY-JET 3569, W.R. Meadows, Inc.
3. Elastomeric Sealant for Concrete:
- a. Superseal 444/777; Crafc0, Inc.
 - b. POLY-JET 3406; W.R. Meadows, Inc.
4. Sealant for Concrete and Asphalt:
- a. ROADSAYER 221; Crafc0 Inc.
 - b. Product #9005; Koch Materials Company.
 - c. Product #9030; Koch Materials Company.
 - d. SEALTIGHT HI-SPEC; W.R. Meadows, Inc.

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 Rod for Cold- and Hot-Applied Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depths 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 depths, 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 depths 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.
- 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 joint sealants to comply with joint sealant manufacturer's written instructions.
- B. 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 applicable to products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations of 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 by proven techniques to 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 so installations with repaired areas are indistinguishable from the original work.

END OF SECTION 32 1373

SECTION 32 1723 - PAVEMENT MARKINGS

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 painted markings applied to asphalt or concrete pavement.
- B. Related Requirements:
 - 1. Section 07 1800 "Traffic Coatings" for painting whole areas of building floors and pavements with coatings having an integral wearing surface.
 - 2. Section 09 9113 "Exterior Painting" for painting exterior concrete surfaces other than pavement.
 - 3. Section 09 9123 "Interior Painting" for painting interior concrete surfaces other than pavement.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project Site: 1100 North Valley View Drive, Layton, Utah 84040
 - 1. Review methods and procedures related to marking pavement including, but not limited to, the following:
 - a. Pavement aging period before application of pavement markings.
 - b. Review requirements for protecting pavement markings, including restriction of traffic during installation period.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include technical data and tested physical and performance properties.
- B. Shop Drawings: For pavement markings.
 - 1. Indicate pavement markings, colors, lane separations, defined parking spaces, and dimensions to adjacent work.
 - 2. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.

- C. Samples: For each exposed product and for each color and texture specified; on rigid backing, 8 inches square.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements for pavement-marking work.
 - 1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for alkyd materials, 55 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Sherwin Williams Pro Park Waterborne Traffic Marking Paint.
- B. Gem Seal Pro-Stripe Plus Waterborne Acrylic Traffic Paint.
- C. 3M Liquid Pavement Marking Series 5000.

2.2 PAVEMENT-MARKING PAINT

- A. Pavement-Marking Paint: MPI #32, solvent-borne traffic-marking paint.
 - 1. Color: White for stall markers and blue for accessibility symbols.
- B. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than three minutes.
 - 1. Color: White for stall markers and blue for accessibility symbols.
- C. Pavement-Marking Paint: MPI #97, latex traffic-marking paint.
 - 1. Color: White for stall markers and blue for accessibility symbols.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that pavement is dry and in suitable condition to begin pavement marking according to manufacturer's written instructions.
- B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

3.2 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
- B. Allow paving to age for a minimum of 30 days 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 14 mils
 - 1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to pavement. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.
 - 2. Broadcast glass beads uniformly into wet markings at a rate of 6 lb./gal.

3.3 PROTECTING AND CLEANING

- A. Protect pavement markings from damage and wear during remainder of construction period.
- B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 32 1723

SECTION 32 1726 - TACTILE WARNING SURFACING

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. Cast-in-place detectable warning tiles.
2. Surface-applied detectable warning tiles.
3. Detectable warning mats.
4. Detectable warning unit pavers.

B. Related Requirements:

1. Section 32 1313 "Concrete Paving" for concrete walkways serving as substrates for tactile warning surfacing.
2. Section 32 1400 "Unit Paving" for unit paving installations incorporating detectable warning unit pavers specified in this Section.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: For each type of exposed finish requiring color selection.
- C. Samples for Verification: For each type of tactile warning surface, in manufacturer's standard sizes unless otherwise indicated, showing edge condition, truncated-dome pattern, texture, color, and cross section; with fasteners and anchors.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For tactile warning surfacing, to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Layton Fire Station; 1100 North Valley View Drive, Layton City, Utah 84040.

1.7 PROJECT CONDITIONS

- A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.
- B. Weather Limitations for Adhesive Application:
 - 1. Apply adhesive only when ambient temperature is above 50 deg F and when temperature has not been below 35 deg F for 12 hours immediately before application. Do not apply when substrate is wet or contains excess moisture.
- C. Weather Limitations for Mortar and Grout:
 - 1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
 - 2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602. Provide artificial shade and windbreaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F and higher.
 - a. When ambient temperature exceeds 100 deg F, or when wind velocity exceeds 8 mph and ambient temperature exceeds 90 deg F, set unit pavers within 1 minute of spreading setting-bed mortar.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of tactile warning surfaces 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 and wear.
 - b. Separation or delamination of materials and components.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TACTILE WARNING SURFACING, GENERAL

- A. Accessibility Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for tactile warning surfaces.

1. For tactile warning surfaces composed of multiple units, provide units that when installed provide consistent side-to-side and end-to-end dome spacing that complies with requirements.
- B. Source Limitations: Obtain each type of tactile warning surfacing, joint material], setting material, anchor, and fastener from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

2.2 DETECTABLE WARNING TILES

- A. Cast-in-Place Detectable Warning Tiles: Accessible truncated-dome detectable warning tiles configured for setting flush in new concrete walkway surfaces, with slip-resistant surface treatment on domes and field of tile.
 1. Manufacturer:
 - a. Armor-Tile Cast In Place Truncated Dome Detectable Panel.
 - b. ADA Solutions Cast In Place Truncated Dome Detectable Panel.
 - c. Access Tile Cast In Place Truncated Dome Detectable Panel.
 - d. DWS Detectable Warning Systems Cast In Place Truncated Dome Detectable Panel.
 2. Material: Cast-fiber-reinforced polymer concrete tile, Molded glass- or carbon-fiber-reinforced polyester.
 3. Color: Safety yellow.
 4. Shapes and Sizes:
 - a. Verify in field at locations indicated in the Construction Drawings.
 5. Dome Spacing and Configuration: 1.6inch – 2.4inch on center truncated dome spacing on center pattern.
 6. Mounting:
 - a. Permanently embedded detectable warning tile wet-set into freshly poured concrete.
 - b. Detectable warning tile set into formed recess in concrete and adhered with adhesive.
 - c. Replaceable detectable warning tile wet-set into freshly poured concrete and surface-fastened to permanently embedded anchors.

2.3 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of tactile warning surfaces, noncorrosive and compatible with each material joined, and complying with the following:
 1. Furnish Stainless-steel fasteners for exterior use.
 2. Fastener Heads: For nonstructural connections, use flathead or oval countersunk screws and bolts with tamper-resistant heads, colored to match tile.
- B. Adhesive: As recommended by manufacturer for adhering tactile warning surfacing unit to pavement.

- C. Sealant: As recommended by manufacturer for sealing perimeter of tactile warning surfacing unit.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that pavement is in suitable condition to begin installation according to manufacturer's written instructions. Verify that installation of tactile warning surfacing will comply with accessibility requirements upon completion.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF TACTILE WARNING SURFACING

- A. General: Prepare substrate and install tactile warning surfacing according to manufacturer's written instructions unless otherwise indicated.
- B. Place tactile warning surfacing units in dimensions and orientation indicated. Comply with location requirements of AASHTO MP 12.

3.3 INSTALLATION OF DETECTABLE WARNING TILES

- A. Cast-in-Place Detectable Warning Tiles:
 - 1. Concrete Paving Installation: Comply with installation requirements in Section 32 1313 "Concrete Paving." Mix, place, and finish concrete to conditions complying with detectable warning tile manufacturer's written requirements for satisfactory embedment of tile.
 - 2. Set each detectable warning tile accurately and firmly in place and completely seat tile back and embedment in wet concrete by tamping or vibrating. If necessary, temporarily apply weight to tiles to ensure full contact with concrete.
 - 3. Set surface of tile flush with surrounding concrete and adjacent tiles, with variations between tiles and between concrete and tiles not exceeding plus or minus 1/8 inch from flush.
 - 4. Protect exposed surfaces of installed tiles from contact with wet concrete. Complete finishing of concrete paving surrounding tiles. Remove concrete from tile surfaces.
 - 5. Clean tiles using methods recommended in writing by manufacturer.
- B. Removable Cast-in-Place Detectable Warning Tiles:
 - 1. Concrete Paving Installation: Comply with installation requirements in Section 32 1313 "Concrete Paving." Mix, place, and finish concrete to conditions complying with detectable warning tile manufacturer's written requirements for satisfactory embedment of removable tile.
 - 2. Set each detectable warning tile accurately and firmly in place with embedding anchors and fasteners attached, and firmly seat tile back in wet concrete by

tamping or vibrating. If necessary, temporarily apply weight to tiles to ensure full contact with concrete.

3. Set surface of tile flush with surrounding concrete and adjacent tiles, with variations between tiles and between concrete and tiles not exceeding plus or minus 1/8 inch from flush.
4. Protect exposed surfaces of installed tiles from contact with wet concrete. Complete finishing of concrete paving surrounding tiles. Remove concrete from tile surfaces.
5. Clean tiles using methods recommended in writing by manufacturer.

C. Surface-Applied Detectable Warning Tiles:

1. Lay out detectable warning tiles as indicated and mark concrete pavement.
2. Prepare existing paving surface by grinding and cleaning as recommended by manufacturer.
 - a. Cut perimeter kerf in existing concrete pavement to receive metal tile flange.
3. Apply adhesive to back of tiles in amounts and pattern recommended by manufacturer and set tiles in place. Firmly seat tiles in adhesive bed, eliminating air pockets and establishing full adhesion to pavement. If necessary, temporarily apply weight to tiles to ensure full contact with concrete.
4. Install anchor devices through face of tiles and into pavement using anchors located as recommended by manufacturer. Set heads of anchors flush with top surface of mat.
5. Mask perimeter of tiles and adjacent concrete and apply sealant in continuous bead around perimeter of tile installation.
6. Remove masking, adhesive, excess sealant, and soil from exposed surfaces of detectable warning tiles and surrounding concrete pavement using cleaning agents recommended in writing by manufacturer.
7. Protect installed tiles from traffic until adhesive has set.

3.4 INSTALLATION OF DETECTABLE WARNING MATS

- A. Lay out detectable warning mats as indicated and mark concrete pavement at edges of mats.
- B. Prepare existing paving surface by grinding and cleaning as recommended by manufacturer.
- C. Apply adhesive to back of mat in amounts and pattern recommended by manufacturer and set mat in place. Firmly seat mat in adhesive bed, eliminating air pockets and establishing full adhesion to pavement. If necessary, temporarily apply weight to mat to ensure full contact with adhesive.
- D. Install anchor devices through face of mat and into pavement using anchors located as recommended by manufacturer. Set heads of anchors flush with mat surface.
- E. Mask mat perimeter and adjacent concrete and apply sealant in continuous bead around perimeter of mat.

- F. Remove masking, adhesive, excess sealant, and soil from exposed surfaces of detectable warning mat and surrounding concrete pavement using cleaning agents recommended in writing by manufacturer.
- G. Protect installed mat from traffic until adhesive has set.

3.5 CLEANING AND PROTECTION

- A. Remove and replace tactile warning surfacing that is broken or damaged or does not comply with requirements in this Section. Remove in complete sections from joint to joint unless otherwise approved by Architect. Replace using tactile warning surfacing installation methods acceptable to Architect.
- B. Protect tactile warning surfacing from damage and maintain free of stains, discoloration, dirt, and other foreign material.

END OF SECTION 32 1726

SECTION 32 8400 - PLANTING IRRIGATION

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. Piping.
2. Manual valves.
3. Automatic control valves.
4. Transition fittings.
5. Dielectric fittings.
6. Miscellaneous piping specialties.
7. Sprinklers.
8. Quick couplers.
9. Drip irrigation specialties.
10. Controllers.
11. Boxes for automatic control valves.

1.3 DEFINITIONS

- A. Circuit Piping: Downstream from control valves to sprinklers, specialties, and drain valves. Piping is under pressure during flow.
- B. Drain Piping: Downstream from circuit-piping drain valves. Piping is not under pressure.
- C. Main Piping: Downstream from point of connection to water distribution piping to, and including, control valves. Piping is under water-distribution-system pressure.
- D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.4 PERFORMANCE REQUIREMENTS

- A. Irrigation zone control shall be automatic operation with controller and automatic control valves.
- B. Location of Sprinklers and Specialties: Design location is approximate. Make minor adjustments necessary to avoid plantings and obstructions such as signs and light standards. Maintain 100 percent irrigation coverage of areas indicated.

- C. Minimum Working Pressures: The following are minimum pressure requirements for piping, valves, and specialties unless otherwise indicated:

1. Irrigation Main Piping: 70 psig.
2. Circuit Piping: 40 psig.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories.
- B. Wiring Diagrams: For power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Irrigation systems, drawn to scale, on which components are shown and coordinated with each other, using input from Installers of the items involved. Also include adjustments necessary to avoid plantings and obstructions such as signs and light standards.
- B. Qualification Data: For qualified Installer.
- C. Zoning Chart: Show each irrigation zone and its control valve.
- D. Controller Timing Schedule: Indicate timing settings for each automatic controller zone.
- E. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sprinklers, controllers and automatic control valves to include in operation and maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: The irrigation system installer shall have a minimum of five years' experience of commercial irrigation projects.
- 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.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver piping 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 piping protected from direct sunlight. Support to prevent sagging and bending.

1.10 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of water service.
 - 2. Do not proceed with interruption of water service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Comply with requirements in the piping schedule for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.
- B. Galvanized-Steel Pipe: ASTM A 53/A 53M, Standard Weight, Type E, Grade B.
 - 1. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Standard Weight, seamless-steel pipe with threaded ends.
 - 2. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
 - 3. Malleable-Iron Unions: ASME B16.39, Class 150, hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface, and female threaded ends.
- C. PVC Pipe: ASTM D 1785, PVC 1120 compound, Schedules 40 and 80.
 - 1. PVC Socket Fittings: ASTM D 2466, Schedules 40 and 80.
 - 2. PVC Threaded Fittings: ASTM D 2464, Schedule 80.
 - 3. PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket ends.

2.2 PIPING JOINING MATERIALS

- A. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.3 MANUAL VALVES

- A. Curb Valves:
 - 1. Description:

- a. NPS 1-1/4 to NPS 2 (DN 32 to DN 50) Pressure Rating: 150 psig (1035 kPa).
 - b. Body Material: Brass or bronze with ball or ground-key plug.
 - c. End Connections: Matching piping.
 - d. Stem: With wide-tee head.
- B. Curb-Valve Casing:
1. Standard: Similar to AWWA M44 for cast-iron valve casings.
 2. Top Section: Telescoping, of length required for depth of burial of curb valve.
 3. Barrel: Approximately 3-inch (75-mm) diameter.
 4. Plug: With lettering "WATER."
 5. Bottom Section: With base of size to fit over valve.
 6. Base Support: Concrete collar.
- C. Shutoff Rods for Curb-Valve Casings: Furnish one steel, tee-handle shutoff rod with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve for Project.
- D. Brass Ball Valves:
1. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).
 - c. Body Design: Two piece.
 - d. Body Material: Forged brass.
 - e. Ends: Threaded.
 - f. Seats: PTFE or TFE.
 - g. Stem: Brass.
 - h. Ball: Chrome-plated brass.
 - i. Port: Full.
- E. Bronze Ball Valves:
1. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).
 - c. Body Design: Two piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded.
 - f. Seats: PTFE or TFE.
 - g. Stem: Bronze.
 - h. Ball: Chrome-plated brass.
 - i. Port: Full.
- F. Plastic Ball Valves:
1. Description:
 - a. Standard: MSS SP-122.
 - b. Pressure Rating: 150 psig (1035 kPa).
 - c. Body Material: PVC.

- d. Type: Union.
- e. End Connections: Socket or threaded.
- f. Port: Full.

G. Bronze Gate Valves:

1. Description:

- a. Standard: MSS SP-80, Type 2.
- b. Class: 125.
- c. CWP Rating: 200 psig (1380 kPa).
- d. Body Material: ASTM B 62 bronze with integral seat and screw-in bonnet.
- e. Ends: Threaded.
- f. Stem: Bronze, nonrising.
- g. Disc: Solid wedge; bronze.
- h. Packing: Asbestos free.
- i. Handwheel: Malleable iron, bronze, or aluminum.

2.4 AUTOMATIC CONTROL VALVES

A. Plastic, Automatic Control Valves:

1. Description: Molded-plastic body, normally closed, diaphragm type with manual-flow adjustment, and operated by 24-V ac solenoid.

2.5 DIELECTRIC FITTINGS

A. General Requirements: 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. Description: Factory-fabricated union, NPS 2 (DN 50) and smaller.
- a. Pressure Rating: 250 psig (1725 kPa) at 180 deg F (82 deg C).
 - b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded ferrous.
 - c. Washers: Phenolic with steel backing washers.

2.6 SPRINKLERS

A. General Requirements: Designed for uniform coverage over entire spray area indicated at available water pressure.

B. Plastic, Pop-up, Gear-Drive Rotary Sprinklers:

1. Description:

- a. Body Material: ABS.

- b. Nozzle: ABS.
 - c. Retraction Spring: Stainless steel.
 - d. Internal Parts: Corrosion resistant.
2. Capacities and Characteristics:
- a. Flow: 40 gpm.
 - b. Pop-up Height: 4 inches (100 mm) above ground to nozzle.
 - c. Arc: As indicated.
 - d. Radius: As indicated.
 - e. Inlet: NPS 1/2 or NPS 3/4 (DN 15 or DN 20).
- C. Plastic, Pop-up Spray Sprinklers:
1. Description:
- a. Body Material: ABS.
 - b. Nozzle: ABS.
 - c. Retraction Spring: Stainless steel.
 - d. Internal Parts: Corrosion resistant.
 - e. Pattern: Fixed, with flow adjustment.
2. Capacities and Characteristics:
- a. Nozzle: ABS.
 - b. Flow: As indicated.
 - c. Pop-up Height: 4 inches (100 mm) aboveground to nozzle.
 - d. Arc: As indicated.
 - e. Radius: As indicated.
 - f. Inlet: NPS 1/2 (DN 15).

2.7 QUICK COUPLERS

- A. Description: Factory-fabricated, bronze or brass, two-piece assembly. Include coupler water-seal valve; removable upper body with spring-loaded or weighted, rubber-covered cap; hose swivel with ASME B1.20.7, 3/4-11.5NH threads for garden hose on outlet; and operating key.
1. Locking-Top Option: Vandal-resistant locking feature. Include one each matching key.

2.8 DRIP IRRIGATION SPECIALTIES

- A. Freestanding Emitters: Device to deliver water at approximately 20 psig (138 kPa).
1. Body Material: PE or vinyl, with flow control.
2. Riser to Emitter: PE or PVC flexible tubing.
3. Capacities and Characteristics:
- a. Flow: as indicated at approximately 20 psig (138 kPa).
 - b. Tubing: PE or PVC; 1/8-inch (3-mm) minimum ID.
 - c. Mounting Height: 6-inch aboveground to nozzle.

- B. Manifold Emitter Systems: Manifold with tubing and emitters.
 - 1. Manifold: With multiple outlets to deliver water to emitters.
 - a. Body Material: Plastic.
 - b. Outlet Caps: Plastic, for outlets without installed tubing.
 - c. Operation: Automatic pressure compensating.
 - 2. Tubing: PE or PVC; 1/8-inch (3-mm) minimum ID.
 - 3. Emitter: Device to deliver water at approximately 20 psig (138 kPa).
 - a. Body Material: PE or vinyl, with flow control.
 - 4. Capacities and Characteristics: As indicated.
- C. Multiple-Outlet Emitter Systems: Emitter with tubing and button-type outlets.
 - 1. Emitter: With multiple outlets to deliver water to remote outlets.
 - a. Body Material: Plastic, with flow control.
 - b. Outlet Caps: Plastic, for outlets without installed tubing.
 - c. Operation: Automatic pressure compensating.
 - d. Emitters: Devices to deliver water at approximately 20 psig (138 kPa.)
 - 2. Tubing: PE or PVC; 1/8-inch (3-mm) minimum ID.
 - 3. Capacities and Characteristics: As indicated.
- D. Drip Tubes with Direct-Attached Emitters:
 - 1. Tubing: Flexible PE or PVC with plugged end.
 - 2. Emitters: Devices to deliver water at approximately 20 psig (138 kPa).
 - a. Body Material: PE or vinyl, with flow control.
 - b. Mounting: Inserted into tubing at set intervals.
 - 3. Capacities and Characteristics: As indicated.
- E. Drip Tubes with Remote Discharge:
 - 1. Tubing: Flexible PE or PVC with plugged end.
 - 2. Emitters: Devices to deliver water at approximately 20 psig (138 kPa).
 - a. Body Material: PE or vinyl, with flow control.
 - b. Mounting: Inserted into tubing at set intervals.
 - 3. Capacities and Characteristics: As indicated.
- F. Off-Ground Supports: Plastic stakes.
- G. Application Pressure Regulators: Brass or plastic housing, NPS 3/4 (DN 20), with corrosion-resistant internal parts; capable of controlling outlet pressure to approximately 20 psig (138 kPa).

- H. Filter Units: Plastic housing, with corrosion-resistant internal parts; of size and capacity required for devices downstream from unit.
- I. Air Relief Valves: Brass or plastic housing, with corrosion-resistant internal parts.
- J. Vacuum Relief Valves: Brass or plastic housing, with corrosion-resistant internal parts.

2.9 CONTROLLERS

A. Description:

1. Controller Stations for Automatic Control Valves: Each station is variable from approximately 5 to 60 minutes. Include switch for manual or automatic operation of each station.
2. Interior Control Enclosures: NEMA 250, Type 12, dripproof, with locking cover and two matching keys.
 - a. Body Material: Molded plastic.
 - b. Mounting: Surface type for wall.
3. Control Transformer: 24-V secondary, with primary fuse.
4. Timing Device: Adjustable, 24-hour, 14-day clock, with automatic operations to skip operation any day in timer period, to operate every other day, or to operate two or more times daily.
 - a. Manual or Semiautomatic Operation: Allows this mode without disturbing preset automatic operation.
 - b. Nickel-Cadmium Battery and Trickle Charger: Automatically powers timing device during power outages.
 - c. Surge Protection: Metal-oxide-varistor type on each station and primary power.
5. Moisture Sensor: Adjustable from one to seven days, to shut off water flow during rain.
6. Wiring: UL 493, Type UF multiconductor, with solid-copper conductors; insulated cable; suitable for direct burial.
 - a. Feeder-Circuit Cables: No. 12 AWG minimum, between building and controllers.
 - b. Low-Voltage, Branch-Circuit Cables: No. 14 AWG minimum, between controllers and automatic control valves; color-coded different from feeder-circuit-cable jacket color; with jackets of different colors for multiple-cable installation in same trench.
 - c. Splicing Materials: Manufacturer's packaged kit consisting of insulating, spring-type connector or crimped joint and epoxy resin moisture seal; suitable for direct burial.

2.10 BOXES FOR AUTOMATIC CONTROL VALVES

A. Plastic Boxes:

1. Description: Box and cover, with open bottom and openings for piping; designed for installing flush with grade.
 - a. Size: As required for valves and service.
 - b. Shape: Round, Rectangular.
 - c. Sidewall Material: PE, ABS, or FRP.
 - d. Cover Material: PE, ABS, or FRP.
 - 1) Lettering: "IRRIGATION."
- B. Drainage Backfill: Cleaned gravel or crushed stone, graded from 3/4 inch (19 mm) minimum to 1-1/2 inches (37 mm) maximum.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."
- B. Install warning tape directly above pressure piping, 12 inches (300 mm) below finished grades, except 6 inches (150 mm) below subgrade under pavement and slabs.
- C. Drain Pockets: Excavate to sizes indicated. Backfill with cleaned gravel or crushed stone, graded from 3/4 to 1-1/2 inches (19 to 37 mm), to 12 inches (300 mm) below grade. Cover gravel or crushed stone with sheet of asphalt-saturated felt and backfill remainder with excavated material.
- D. Provide minimum cover over top of underground piping according to the following:
 1. Irrigation Main Piping: Minimum depth of 36 inches (900 mm) below finished grade, or not less than 18 inches (450 mm) below average local frost depth, whichever is deeper.
 2. Circuit Piping: 12 inches (300 mm).
 3. Drain Piping: 12 inches (300 mm).
 4. Sleeves: 24 inches (600 mm).

3.2 PREPARATION

- A. Set stakes to identify locations of proposed irrigation system. Obtain Architect's approval before excavation.

3.3 PIPING INSTALLATION

- A. Location and Arrangement: Drawings indicate location and arrangement of piping systems. Install piping as indicated unless deviations are approved on Coordination Drawings.
- B. Install piping at minimum uniform slope of 0.5 percent down toward drain valves.

- C. Install piping free of sags and bends.
- D. Install groups of pipes parallel to each other, spaced to permit valve servicing.
- E. Install fittings for changes in direction and branch connections.
- F. Install unions adjacent to valves and to final connections to other components with NPS 2 (DN 50) or smaller pipe connection.
- G. Install underground thermoplastic piping according to ASTM D 2774.
- H. Lay piping on solid subbase, uniformly sloped without humps or depressions.
- I. Install PVC piping in dry weather when temperature is above 40 deg F (5 deg C). Allow joints to cure at least 24 hours at temperatures above 40 deg F (5 deg C) before testing.
- J. Install piping in sleeves under parking lots, roadways, and sidewalks.
- K. Install sleeves made of Schedule 40 PVC pipe and socket fittings, and solvent-cemented joints.
- L. Install transition fittings for plastic-to-metal pipe connections according to the following:
 - 1. Underground Piping:
 - a. NPS 1-1/2 (DN 40) and Smaller: Plastic-to-metal transition fittings.
 - b. NPS 2 (DN 50) and Larger: AWWA transition couplings.
 - 2. Aboveground Piping:
 - a. NPS 2 (DN 50) and Smaller: Plastic-to-metal transition unions.
 - b. NPS 2 (DN 50) and Larger: Use dielectric flange kits with one plastic flange.
- M. Install dielectric fittings for dissimilar-metal pipe connections according to the following:
 - 1. Aboveground Piping:
 - a. NPS 2 (DN 50) and Smaller: Dielectric union.

3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. 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.
- D. PVC 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. 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.
 3. PVC Nonpressure Piping: Join according to ASTM D 2855.

3.5 VALVE INSTALLATION

- A. Underground Curb Valves: Install in curb-valve casings with tops flush with grade.
- B. Aboveground Valves: Install as components of connected piping system.
- C. Drain Valves: Install in underground piping in boxes for automatic control valves.

3.6 SPRINKLER INSTALLATION

- A. Install sprinklers after hydrostatic test is completed.
- B. Install sprinklers at manufacturer's recommended heights.
- C. Locate part-circle sprinklers to maintain a minimum distance of 4 inches (100 mm) from walls and 2 inches (50 mm) from other boundaries unless otherwise indicated.

3.7 DRIP IRRIGATION SPECIALTY INSTALLATION

- A. Install freestanding emitters on pipe riser to mounting height indicated.
- B. Install manifold emitter systems with tubing to emitters. Plug unused manifold outlets. Install emitters on off-ground supports at height indicated.
- C. Install multiple-outlet emitter systems with tubing to outlets. Plug unused emitter outlets. Install outlets on off-ground supports at height indicated.
- D. Install drip tubes with direct-attached emitters on ground.
- E. Install drip tubes with remote-discharge on ground with outlets on off-ground supports at height indicated.
- F. Install off-ground supports of length required for indicated mounted height of device.

3.8 AUTOMATIC IRRIGATION-CONTROL SYSTEM INSTALLATION

- A. Equipment Mounting: Install interior controllers on wall.
 - 1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
- B. Install control cable in same trench as irrigation piping and at least 6 inches (150 mm) below or beside piping. Provide conductors of size not smaller than recommended by controller manufacturer. Install cable in separate sleeve under paved areas.

3.9 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221113 "Facility Water Distribution Piping" for water supply from exterior water service piping, water meters, protective enclosures, and backflow preventers. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment, valves, and devices to allow service and maintenance.
- C. Connect wiring between controllers and automatic control valves.

3.10 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on each automatic controller.
- C. Warning Tapes: Arrange for installation of continuous, underground, detectable warning tapes over underground piping during backfilling of trenches. See Section 312000 "Earth Moving" for warning tapes.

3.11 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 2. Operational Test: After electrical circuitry has been energized, operate controllers and automatic control valves to confirm proper system operation.
 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Any irrigation product will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.12 STARTUP SERVICE

- A. Perform startup service.
1. Complete installation and startup checks according to manufacturer's written instructions.
 2. Verify that controllers are installed and connected according to the Contract Documents.
 3. Verify that electrical wiring installation complies with manufacturer's submittal.

3.13 ADJUSTING

- A. Adjust settings of controllers.
- B. Adjust automatic control valves to provide flow rate at rated operating pressure required for each sprinkler circuit.
- C. Adjust sprinklers and devices, except those intended to be mounted aboveground, so they will be flush with, or not more than 1/2 inch (13 mm) above, finish grade.

3.14 CLEANING

- A. Flush dirt and debris from piping before installing sprinklers and other devices.

3.15 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain automatic control valves and controllers.

3.16 PIPING SCHEDULE

- A. Install components having pressure rating equal to or greater than system operating pressure.
- B. Aboveground irrigation main piping, NPS 4 (DN 100) and smaller, shall be the following:

1. Galvanized-steel pipe and galvanized-steel pipe nipples; galvanized, gray-iron threaded fittings; and threaded joints.
- C. Underground irrigation main piping, NPS 4 (DN 100) and smaller, shall be the following:
1. Schedule 40, PVC pipe and socket fittings, and solvent-cemented joints.
- D. Circuit piping, NPS 2 (DN 50) and smaller, shall be the following:
1. Schedule 40, PVC pipe and socket fittings; and solvent-cemented joints.
- E. Underground Branches and Offsets at Sprinklers and Devices: Schedule 80, PVC pipe; threaded PVC fittings; and threaded joints.
1. Option: Plastic swing-joint assemblies, with offsets for flexible joints, manufactured for this application.
- F. Risers to Aboveground Sprinklers and Specialties: Schedule 80, PVC pipe and socket fittings; and solvent-cemented joints.
- G. Drain piping shall be the following:
1. Schedule 40, PVC pipe and socket fittings; and solvent-cemented joints.

3.17 VALVE SCHEDULE

- A. Underground, Shutoff-Duty Valves: Use the following:
1. NPS 2 (DN 50) and Smaller: Curb valve, curb-valve casing, and shutoff rod.
- B. Drain Valves:
1. NPS 1/2 and NPS 3/4 (DN 15 and DN 20): Plastic ball valve.
 2. NPS 1 to NPS 2 (DN 25 to DN 50): Brass or bronze ball valve.

END OF SECTION 32 8400

SECTION 32 91 15 - SOIL PREPARATION

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 planting soils specified according to performance requirements of the mixes.
- B. Related Requirements:
 - 1. Section 329300 "Plants" for placing planting soil for plantings.

1.3 DEFINITIONS

- A. AAPFCO: Association of American Plant Food Control Officials.
- B. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.
- C. CEC: Cation exchange capacity.
- D. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.
- E. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.
- F. Imported Soil: Soil that is transported to Project site for use.
- G. Layered Soil Assembly: A designed series of planting soils, layered on each other, that together produce an environment for plant growth.
- H. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.
- I. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of analytical data.

- J. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."
 - K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
 - L. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.
 - M. SSSA: Soil Science Society of America.
 - N. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
 - O. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
 - P. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.
 - Q. USCC: U.S. Composting Council.
- 1.4 PREINSTALLATION MEETINGS
- A. Preinstallation Conference: Conduct conference at Project site.
- 1.5 ACTION SUBMITTALS
- A. Product Data: For each type of product.
 - 1. Include recommendations for application and use.
 - 2. Include test data substantiating that products comply with requirements.
 - 3. Include sieve analyses for aggregate materials.
 - 4. Material Certificates: For each type of imported soil, soil amendment and fertilizer before delivery to the site, according to the following:
 - a. Manufacturer's qualified testing agency's certified analysis of standard products.
 - b. Analysis of fertilizers, by a qualified testing agency, made according to AAPFCO methods for testing and labeling and according to AAPFCO's SUIP #25.
 - c. Analysis of nonstandard materials, by a qualified testing agency, made according to SSSA methods, where applicable.

1.6 INFORMATIONAL SUBMITTALS

- A. Preconstruction Test Reports: For preconstruction soil analyses specified in "Preconstruction Testing" Article.
- B. Field quality-control reports.

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.
 - 1. Multiple Laboratories: At Contractor's option, work may be divided among qualified testing laboratories specializing in physical testing, chemical testing, and fertility testing.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction soil analyses on existing, on-site soil and imported soil.
- B. Preconstruction Soil Analyses: For each unamended soil type, perform testing on soil samples and furnish soil analysis and a written report containing soil-amendment and fertilizer recommendations by a qualified testing agency performing the testing.
 - 1. Have testing agency identify and label samples and test reports according to sample collection and labeling requirements.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.
- B. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 - 3. Do not move or handle materials when they are wet or frozen.
 - 4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

PART 2 - PRODUCTS

2.1 PLANTING SOILS SPECIFIED ACCORDING TO PERFORMANCE REQUIREMENTS

- A. Planting-Soil Type: Existing, on-site surface soil, with the duff layer, if any, retained; modified to produce viable planting soil. Using preconstruction soil analyses and materials specified in other articles of this Section, amend existing, on-site surface soil to become planting soil complying with the following requirements:
1. Particle Size Distribution by USDA Textures: Classified as sandy loam soil according to USDA textures.
 2. Percentage of Organic Matter: Minimum 6 percent by volume.
 3. Soil Reaction: pH of 6 to 7.
- B. Imported Planting-Soil Type: Imported, naturally formed soil from off-site sources and consisting of sandy loam according to USDA textures; and modified to produce viable planting soil. Amend imported soil with materials specified in other articles of this Section to become planting soil complying with the following requirements:
1. Sources: Take imported, unamended soil from sources that are naturally well-drained sites where topsoil occurs at least 4 inches (100 mm) deep, not from bogs, or marshes; and that do not contain undesirable organisms; disease-causing plant pathogens; or obnoxious weeds and invasive plants including, but not limited to, quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and brome grass.
 2. Additional Properties of Imported Soil before Amending: Minimum of 6 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration. Clean soil to be of the following:
 - a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
 - b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 8 percent by dry weight of the imported soil.
 - c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 2 inches (50 mm) in any dimension.

2.2 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
1. Class: T, with a minimum of 99 percent passing through a No. 8 (2.36-mm) sieve and a minimum of 75 percent passing through a No. 60 (0.25-mm) sieve.
- B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a No. 6 (3.35-mm) sieve and a maximum of 10 percent passing through a No. 40 (0.425-mm) sieve.

- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- D. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through a No. 50 (0.30-mm) sieve.
- E. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to ASTM C 33/C 33M.

2.3 ORGANIC SOIL AMENDMENTS

- A. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance," and as follows:
 - 1. Reaction: pH of 5.5 to 8 .
 - 2. Soluble-Salt Concentration: Less than 4 dS/m.
 - 3. Moisture Content: 35 to 55 percent by weight.
 - 4. Organic-Matter Content: 30 to 40 percent of dry weight.
 - 5. Particle Size: Minimum of 98 percent passing through a 1/2-inch (13-mm) sieve.
- B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture with 100 percent passing through a 1/2-inch (13-mm) sieve, a pH of 3.4 to 4.8, and a soluble-salt content measured by electrical conductivity of maximum 5 dS/m.
- C. Wood Derivatives: Shredded and composted, nitrogen-treated ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.
 - 1. Partially Decomposed Wood Derivatives: In lieu of shredded and composted wood derivatives, mix shredded and partially decomposed wood derivatives with ammonium nitrate at a minimum rate of 0.15 lb/cu. ft. (2.4 kg/cu. m) of ground bark, or with ammonium sulfate at a minimum rate of 0.25 lb/cu. ft. (4 kg/cu. m) of ground bark.
- D. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.4 FERTILIZERS

- A. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 33 percent available phosphoric acid.
- B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 - 1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

- C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

PART 3 - EXECUTION

3.1 GENERAL

- A. Place planting soil and fertilizers according to requirements in other Specification Sections.
- B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.
- C. Proceed with placement only after unsatisfactory conditions have been corrected.

3.2 PLACING AND MIXING PLANTING SOIL OVER EXPOSED SUBGRADE

- A. General: Apply and mix unamended soil with amendments on-site to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.
- B. Subgrade Preparation: Till subgrade to a minimum depth of 6 inches (150 mm). Remove stones larger than 1-1/2 inches (38 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Apply, add soil amendments, and mix approximately half the thickness of unamended soil over prepared, loosened subgrade according to "Mixing" Paragraph below. Mix thoroughly into top 4 inches (100 mm) of subgrade. Spread remainder of planting soil.
- C. Mixing: Spread unamended soil to total depth of 12 inches (300 mm), but not less than required to meet finish grades after mixing with amendments and natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.
 - 1. Amendments: Apply soil amendments and fertilizer, if required, evenly on surface, and thoroughly blend them with unamended soil to produce planting soil.
- D. Compaction: Compact each blended lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698.
- E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform the following tests:
 - 1. Performance Testing: For each amended planting-soil type, demonstrating compliance with specified performance requirements.
- C. Soil will be considered defective if it does not pass tests.
- D. Prepare test reports.
- E. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

3.4 PROTECTION

- A. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Parking vehicles or equipment.
 - 3. Vehicle traffic.
 - 4. Foot traffic.
 - 5. Erection of sheds or structures.
 - 6. Impoundment of water.
 - 7. Excavation or other digging unless otherwise indicated.
- B. If planting soil or subgrade is overcompacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by Architect and replace contaminated planting soil with new planting soil.

3.5 CLEANING

- A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.
- B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.
 - 1. Dispose of excess subsoil and unsuitable materials on-site where directed by Owner.

END OF SECTION 32 9115

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Conference:
 - 1. Participate in MANDATORY pre-installation conference as specified in Section 32 9001.
 - 2. In addition to agenda items specified in Section 01 3100, review the following:
 - a. Review compost requirements to be within acceptable range as per Attachment 'Compost Quality Guidelines for Landscaping' and 'Compost Verification Report' in this specification.
 - b. Review soil fertility amendments and fertilizer requirements as per Attachment 'Topsoil Testing Report' in Section 32 9120.

1.3 SUBMITTALS

- A. Action Submittals:
 - 1. Material Data:
 - a. Soil Amendments and Fertilizer:
 - 1) Product literature and chemical / nutrient analysis of soil amendments and fertilizers.
 - 2) Proposed application rates necessary to bring topsoil up to specified requirements.
 - 3) Source location of products.
 - 4) Submit to Landscape Architect for approval prior to installation.
 - 2. Samples:
 - a. Soil Fertility Amendments and Fertilizer:
 - 1) Soil conditioner sample for approval before delivery to site.
 - 2) Product analysis.
- B. Informational Submittals:
 - 1. Testing and Evaluation Reports:
 - a. 'Compost Verification Report':
 - 1) Provide signed copy certifying that compost meets requirements of this specification.
 - 2. Field Quality Control Submittals:
 - a. Soil Fertility Amendments and Fertilizer:
 - 1) Delivery slips indicating amount of soil amendments, compost, conditioner, and fertilizer delivered to Project site.
- C. Closeout Submittals:
 - 1. Include the following in Operations and Maintenance Manual specified in Section 01 7800:
 - a. Record Documentation:
 - 1) Submit 'Compost Verification Report'.
 - 2) Submit delivery slips indicating amount of physical amendments delivered to Project site.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Soil Amendments:
 - 1. Incorporate following soil amendments into topsoil used for Project:
 - a. Acceptable Soil Amendments, Soil Conditioners, And Application Rates.

'Compost': Apply 6 cubic yards per 1000 square feet of organic material for every 3 inches of soil depth. Incorporate well. Organic material to meet COMPOST QUALITY GUIDELINES FOR LANDSCAPING included as attachment at the end of this section.

- b. Acceptable Fertilizers and Application Rates:
 - 1) Apply a 30-10-0 fertilizer at 4 pounds per 1000 square feet.
 - 2) Equal as approved by Architect before installation. See Section 01 6200.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification Of Conditions:
 1. Do not commence work of this Section until imported, stockpiled and in place topsoil are placed as specified in Section 32 9120 'Topsoil and Placement'.

3.2 PREPARATION

- A. Protection Of In-Place Conditions:
 1. Protect utilities and site elements from damage.
- B. Surface Preparation:
 1. Surfaces that meet specified topsoil elevations.
 - a. Seven (7) days maximum before beginning seeding and planting:
 - 1) Loosen topsoil 6 inch (150 mm) deep, dampen thoroughly, and cultivate to properly break up clods and lumps.
 - 2) Rake area to remove clods, rocks, weeds, roots, debris or other material 1-1/2 inches (38 mm) or more in any dimension.
 - 3) Grade and shape landscape area to bring surface to true uniform planes free from irregularities and to provide drainage and proper slope to catch basins.
 2. Addition of Soil Amendments:
 - a. Add specified soil amendments at specified rates to topsoil as directed by Topsoil Testing Report found in Section 32 9120 'Topsoil and Placement'.
 - b. Add specified fertilizers at specified rates into topsoil as directed by Soil Testing Laboratory.
 - c. Roto-fill or otherwise mix soil amendments evenly into topsoil.

3.3 PERFORMANCE

- A. General:
 1. Limit use of heavy equipment to areas no closer than 6 feet (1.80 meter) from building or other permanent structures. Use hand-held tillers for preparation of subsoil in areas closer than 6 feet (1.80 m).
 2. Do not expose or damage existing shrub or tree roots.
- B. Finish Grade Tolerances (As shown on General Planting Details in Contract Documents):
 1. Finish topsoil grade of planting areas before planting and after addition of soil additives shall be specified distances below top of adjacent pavement of any kind:
 - a. Sodded Areas: 2 inches (50 mm) below.
 - b. Tree and Shrub Areas (not individual trees): 4 inches (100 mm) below.
- C. Placed Topsoil:

1. At locations where topsoil has been placed as per Section 32 9120 'Topsoil and Placement', perform the following:
 - a. Remove existing vegetation as required in preparation for new landscaping.
 - b. Remove organic material, rocks and clods greater than 1-1/2 inch (38 mm) in any dimension, and other objectionable materials.

D. Grading:

1. Coordinate grading as described in Section 32 9120 'Topsoil and Placement'.

E. Immediately before planting lawn and with topsoil in semi-dry condition, roll areas that are to receive lawn in two directions at approximately right angles with water ballast roller weighing 100 to 300 lbs (45 to 135 kg), depending on soil type.

F. Rake or scarify and cut or fill irregularities that develop as required until area is true and uniform, free from lumps, depressions, and irregularities.

3.4 PROTECTION

- A. After landscape areas have been prepared, take no heavy objects over them except lawn rollers.

END OF SECTION

2. Eco-Region Irrigation Design: A bio-regional approach to irrigation and planting design that is relevant to the geographic area for which the planting plan and irrigation system is designed. These geographic areas are defined by the Environmental Protection Agency and have been modified by the LDS church into 15 geographical areas throughout North America, and the Hawaiian Islands.
3. Hardiness Zone: A hardiness zone is a more precisely geographically-defined zone within an Eco-Region in which a specific category of plant life is capable of growing, as defined by temperature hardiness, or ability to withstand the minimum temperatures of the zone. Hardiness Zones may be defined by one of two sources:
 - a. Sunset Western Garden Book Maps.
 - b. USDA Hardiness Zone Map.Plant Hardiness zone sources shall be listed by the architect through the planting and irrigation design process.
4. Hydro-Zone: Plants grouped by water needs (similar Crop Coefficients (Kc), organized into one irrigation zone.
5. Reference Evapotranspiration (ETo): The total water lost from the soil (evaporation) and from the plant surface (transpiration) over some period.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Conference:
 1. Participate in pre-installation conference as specified in Section 32 9001.

1.4 SUBMITTALS

- A. Informational Submittals:
 1. Certificates:
 - a. Written certification confirming sod seed mix and quality:
 - 1) Include all species used.
 - 2) Include name and contact information of supplier.
- B. Closeout Submittals:
 1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
 - a. Record Documentation:
 - 1) Submit one (1) copy certificate for sod seed quality and mix.
 - b. Landscape Management Plan (LMP):
 - 1) Landscape Section:
 - a) Submit one (1) copy certificate for sod seed quality and mix.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery And Acceptance Requirements:
 1. Harvest, deliver, store, and handle sod in accordance with requirements of Turfgrass Producers International (TPI) (formally American Sod Producers Association) Specifications for Turfgrass Sod Materials and Transplanting / Installing.
 2. Schedule deliveries to coincide with topsoil operations and laying. Keep storage at job site to minimum without causing delays.
 - a. Deliver, unload, and store sod on pallets within 24 hours of being lifted.
 - b. Do not deliver small, irregular, or broken pieces of sod.
- B. Storage And Handling Requirements:
 1. Cut sod in pieces approximately 3/4 to one inch (19 to 25 mm) thick. Roll or fold sod so it may be lifted and handled without breaking or tearing and without loss of soil.

2. During wet weather, allow sod to dry sufficiently to prevent tearing during lifting and handling.
3. During dry weather, protect sod from drying before installation. Water as necessary to insure vitality and to prevent excess loss of soil in handling. Sod that dries out before installation will be rejected.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Description:
 1. Superior sod grown from certified, high quality, seed of known origin or from plantings of certified grass seedlings or stolons:
 - a. Assure satisfactory genetic identity and purity.
 - b. Assure over-all high quality and freedom from noxious weeds or an excessive amount of other crop and weedy plants at time of harvest.
 2. Sod shall be composed of three varieties minimum of Kentucky Bluegrass:
 - a. Midnight
 - b. Midnight II
 - c. Everest
 - d. Bluestone
 - e. Impact
 - f. Perfection

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Interface With Other Work:
 1. Do not commence work of this Section until work of Sections 32 9122 and 32 9300 has been completed and approved.
- B. Tolerances:
 1. Final grade of soil after sodding of lawn areas is complete shall be one inch (25 mm) below top of adjacent pavement of any kind.
- C. Laying of Sod:
 1. Lay sod during growing season and within 48 hours of being lifted.
 2. Lay sod while top 6 inches (150 mm) of soil is damp, but not muddy. Sodding during freezing temperatures or over frozen soil is not acceptable.
 3. Lay sod in rows perpendicular to slope with joints staggered. Butt sections closely without overlapping or leaving gaps between sections. Cut out irregular or thin sections with a sharp knife.
 4. Lay sod flush with adjoining existing sodded surfaces.
 5. Do not sod slopes steeper than 3:1. Consult with Architect for alternate treatment.
- D. After Laying of Sod Is Complete:
 1. Roll horizontal surface areas in two directions perpendicular to each other.
 2. Repair and re-roll areas with depressions, lumps, or other irregularities. Heavy rolling to correct irregularities in grade will not be permitted.

3. Water sodded areas immediately after laying sod to obtain moisture penetration through sod into top 6 inches (150 mm) of topsoil.
- E. At the end of the 30 day maintenance period fertilize lawns with a 30-10-0 fertilizer at the rate of 4 pounds per 1000 square feet.

3.2 FIELD QUALITY CONTROL

- A. Field Inspection:
 1. Sodded areas will be accepted at Project closeout if:
 - a. Sodded areas are properly established.
 - b. Sod is free of bare and dead spots and is without weeds.
 - c. No surface soil is visible when grass has been cut to height of 2 inches (50 mm).
 2. Sodded areas have been mowed a minimum of twice.

END OF SECTION

SECTION 32 9300 - PLANTS

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. Plants.
 - 2. Tree stabilization.
 - 3. Tree grates.

1.3 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with a ball size not less than [sizes indicated] [diameter and depth recommended by ANSI Z60.1 for type and size of plant required]; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.
- C. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than [sizes indicated] [diameter and depth recommended by ANSI Z60.1 for type and size of plant required].
- D. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than the minimum root spread according to ANSI Z60.1 for type and size of plant required.
- E. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.
- F. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of plant.
- G. Finish Grade: Elevation of finished surface of planting soil.

- H. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.
 - I. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
 - J. Planting Area: Areas to be planted.
 - K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329115 "Soil Preparation" for planting soils.
 - L. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.
 - M. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.
 - N. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.
 - O. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- 1.4 PREINSTALLATION MEETINGS
- A. Preinstallation Conference: Conduct conference at Project site.
- 1.5 ACTION SUBMITTALS
- A. Product Data: For each type of product.
 - 1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
 - B. Samples for Verification: For each of the following:
 - 1. Mineral Mulch: 2 lb (1.0 kg) of each mineral mulch required, in sealed plastic bags labeled with source of mulch. Sample shall be typical of the lot of material to be delivered and installed on-site; provide an accurate indication of color, texture, and makeup of the material.
 - 2. Weed Control Barrier: 12 by 12 inches (300 by 300 mm).
 - 3. Tree Grates, Frames, and Accessories: Manufacturer's standard size delivered to site for review, to verify design and color selected.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.
- B. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:
 - 1. Manufacturer's certified analysis of standard products.
 - 2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- C. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.
- D. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before expiration of required maintenance periods.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.
 - 1. Experience: Five years' experience in landscape installation in addition to requirements in Section 014000 "Quality Requirements."
 - 2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
- B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.
 - 1. Selection of plants purchased under allowances is made by Architect, who tags plants at their place of growth before they are prepared for transplanting.
- C. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.
 - 1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches (150 mm) above the root flare for trees up to 4-inch (100-mm) caliper size, and 12 inches (300 mm) above the root flare for larger sizes.
 - 2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

- D. Plant Material Observation: Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
 - 1. Notify Architect of sources of planting materials seven days in advance of delivery to site.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.
- B. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 - 3. Accompany each delivery of bulk materials with appropriate certificates.
- C. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.
- D. Handle planting stock by root ball.
- E. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
 - 1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.
- F. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.
- G. Deliver plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
 - 1. Heel-in bare-root stock. Soak roots that are in less than moist condition in water for two hours. Reject plants with dry roots.

2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
3. Do not remove container-grown stock from containers before time of planting.
4. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

1.10 FIELD CONDITIONS

- A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.
- B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

1.11 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
 - b. Structural failures including plantings falling or blowing over.
 - c. Faulty performance of tree stabilization, edgings and tree grates.
 - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 2. Warranty Periods: From date of Substantial Completion.
 - a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
 - b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.
 3. Include the following remedial actions as a minimum:
 - a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
 - b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
 - c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.
 - d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch (19 mm) in diameter; or with stem girdling roots are unacceptable.
 2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.
- B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.
- C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.
- D. Labeling: Label at least one plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant.
- E. If formal arrangements or consecutive order of plants is indicated on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

2.2 FERTILIZERS

- A. Planting Tablets: Tightly compressed chip-type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.
1. Size: 10-gram tablets.
 2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

2.3 MULCHES

- A. Mineral Mulch: Hard, durable stone, washed free of loam, sand, clay, and other foreign substances, of the following type, size range, and color:

1. Type: Crushed stone or gravel.
2. Size Range: 2 inches (50 mm).
3. Color: Color range acceptable to Architect.

2.4 WEED-CONTROL BARRIERS

- A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. (101g/sq. m) minimum, composed of fibers formed into a stable network so that fibers retain their relative position. Fabric shall be inert to biological degradation and resist naturally encountered chemicals, alkalis, and acids.

2.5 PESTICIDES

- A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

2.6 TREE-STABILIZATION MATERIALS

- A. Trunk-Stabilization Materials:
 1. Upright and Guy Stakes: Rough-sawn, sound, new [hardwood] [softwood with specified wood pressure-preservative treatment], free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal (38-by-38-mm actual) by length indicated, pointed at one end.
 2. Flexible Ties: Wide rubber or elastic bands or straps of length required to reach stakes.

2.7 TREE GRATES

- A. Tree Grates: Manufacturer's standard tree grates and frames.
 - 1.
 2. Grates: ASTM A 48/A 48M, Class 35 (Class 250) or better, gray-iron castings.
 3. Frames: ASTM A 36/A 36M steel-angle, hot-dip galvanized, of shape, pattern, and size indicated.
- B. Shape and Size: As indicated on Drawings.
- C. Finish: As fabricated.

2.8 MISCELLANEOUS PRODUCTS

- A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.
- B. Burlap: Non-synthetic, biodegradable.
- C. Planter Drainage Gravel: Washed, sound crushed stone or gravel as indicated.
- D. Planter Filter Fabric: Nonwoven geotextile manufactured for separation applications and made of polypropylene, polyolefin, or polyester fibers or combination of them.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.
 - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 - 2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
 - 3. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 - 4. Uniformly moisten excessively dry soil that is not workable or which is dusty.
- B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.

- D. Lay out plants at locations directed by Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

3.3 PLANTING AREA ESTABLISHMENT

- A. General: Prepare planting area for soil placement and mix planting soil according to Section 329115 "Soil Preparation."
- B. Placing Planting Soil: Place manufactured planting soil over exposed subgrade.
- C. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits and Trenches: Excavate circular planting pits.
 - 1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
 - 2. Excavate approximately three times as wide as ball diameter for balled and burlapped container-grown stock.
 - 3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
 - 4. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
 - 5. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
 - 6. Maintain supervision of excavations during working hours.
 - 7. Keep excavations covered or otherwise protected when unattended by Installer's personnel.
- B. Backfill Soil: Subsoil and topsoil removed from excavations may be used as backfill soil unless otherwise indicated.
- C. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
- D. Drainage: Notify Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.
- E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.5 TREE, SHRUB, AND VINE PLANTING

- A. Inspection: At time of planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.
- B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Balled and Burlapped Stock: Set each plant plumb and in center of planting pit or trench with root flare 2 inches (50 mm) above adjacent finish grades.
 - 1. Backfill: Planting soil as indicated.
 - 2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 - 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 - 4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole.
 - a. Quantity: Three for each caliper inch of plant.
 - 5. Continue backfilling process. Water again after placing and tamping final layer of soil.
- D. Slopes: When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.6 TREE, SHRUB, AND VINE PRUNING

- A. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.
- B. Do not apply pruning paint to wounds.

3.7 TREE STABILIZATION

- A. Trunk Stabilization by Upright Staking and Tying: Install trunk stabilization as follows unless otherwise indicated:

1. Upright Staking and Tying: Stake trees of 2- through 5-inch (50- through 125-mm) caliper. Stake trees of less than 2-inch (50-mm) caliper only as required to prevent wind tip out. Use a minimum of two stakes of length required to penetrate at least 18 inches (450 mm) below bottom of backfilled excavation and to extend to the dimension indicated on Drawings above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.
2. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.

3.8 PLACING SOIL IN PLANTERS

- A. Place a layer of drainage gravel at least 4 inches (100 mm) thick in bottom of planter. Cover bottom with filter fabric and wrap filter fabric 6 inches (150 mm) up on all sides. Duct tape along the entire top edge of the filter fabric, to secure the filter fabric against the sides during the soil-filling process.
- B. Fill planter with planting soil. Place soil in lightly compacted layers to an elevation of 3 inches (75 mm) below top of planter, allowing natural settlement.

3.9 GROUND COVER AND PLANT PLANTING

- A. Set out and space plants other than trees, shrubs, and vines as indicated.
- B. Use planting soil for backfill.
- C. Dig holes large enough to allow spreading of roots.
- D. For rooted cutting plants supplied in flats, plant each in a manner that minimally disturbs the root system but to a depth not less than two nodes.
- E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.10 PLANTING AREA MULCHING

- A. Install weed-control barriers before mulching according to manufacturer's written instructions. Completely cover area to be mulched, overlapping edges a minimum of 6 inches (150 mm) secure seams with galvanized pins.
- B. Mulch backfilled surfaces of planting areas and other areas indicated.
 1. Mineral Mulch in Planting Areas: Apply 4-inch (100-mm) average thickness of mineral mulch over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 6 inches (150 mm) of trunks or stems.

3.11 TREE GRATE INSTALLATION

- A. Tree Grates: Install according to manufacturer's written instructions. Set grate segments flush with adjoining surfaces. Shim from supporting substrate with soil-resistant plastic. Maintain a 3-inch (75-mm-) minimum growth radius around base of tree; break away portions of casting, if necessary, according to manufacturer's written instructions.

3.12 PLANT MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.
- B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.13 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Pre-Emergent Herbicides (Selective and Nonselective): Apply to tree, shrub, and ground-cover areas according to manufacturer's written recommendations. Do not apply to seeded areas.
- C. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.14 REPAIR AND REPLACEMENT

- A. General: Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by Architect.
 - 1. Submit details of proposed pruning and repairs.
 - 2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
 - 3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.

- B. Remove and replace trees that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.

- 1. Provide new trees of same size as those being replaced for each tree.
- 2. Species of Replacement Trees: Same species being replaced.

3.15 CLEANING AND PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.
- C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- D. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.
- E. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.

3.16 MAINTENANCE SERVICE

- A. Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:
 - 1. Maintenance Period: Three months from date of Substantial Completion.
- B. Maintenance Service for Ground Cover and Other Plants: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:
 - 1. Maintenance Period: Three months from date of Substantial Completion.

END OF SECTION 32 9300

SECTION 331113 – FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes water-distribution piping and related components outside the building for water service and fire-service mains.
- B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.
- C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
 - 2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
 - 3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.
- D. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.
- E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.
- F. NSF Compliance:
 - 1. Comply with NSF 14 for plastic potable-water-service piping.

2. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.4 PROJECT CONDITIONS

- A. Interruption of Existing Water-Distribution 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 water-distribution service according to requirements indicated:
 1. Notify Owner no fewer than two days in advance of proposed interruption of service.
 2. Do not proceed with interruption of water-distribution service without Owner's written permission.

1.5 COORDINATION

- A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

- A. PVC, AWWA Pipe: AWWA C900, Class 200, with bell end with gasket, and with spigot end.
 1. Comply with UL 1285 for fire-service mains if indicated.
 2. PVC Fabricated Fittings: AWWA C900, Class 200, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
 3. PVC Molded Fittings: AWWA C907, Class 150, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
 4. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.2 JOINING MATERIALS

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for commonly used joining materials.
- B. Brazing Filler Metals: AWS A5.8, BCuP Series.
- C. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

2.3 PIPING SPECIALTIES

- A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- B. Tubular-Sleeve Pipe Couplings:
 - 1. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners and with ends of same sizes as piping to be joined.
 - a. Standard: AWWA C219.

2.4 GATE VALVES

- A. AWWA, Cast-Iron Gate Valves:
 - 1. Non-rising-Stem, Resilient-Seated Gate Valves:
 - a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
 - 1) Standard: AWWA C509.
 - 2) Minimum Pressure Rating: 200 psig.
 - 3) End Connections: Mechanical joint.
 - 4) Interior Coating: Complying with AWWA C550.

2.5 GATE VALVE ACCESSORIES AND SPECIALTIES

- A. Tapping-Sleeve Assemblies:
 - 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, provide products by one of the following:
 - 3. Description: Sleeve and valve compatible with drilling machine.
 - a. Standard: MSS SP-60.
 - b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
 - c. Valve: AWWA, cast-iron, non-rising-stem, resilient-seated gate valve with one raised face flange mating tapping-sleeve flange.
- B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.

1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.
- C. Indicator Posts: UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

2.6 WATER METERS

- A. Water meters will be furnished by utility company.

2.7 FIRE HYDRANTS

- A. Dry-Barrel Fire Hydrants:
 1. Description: Freestanding, with one NPS 4-1/2 and two NPS 2-1/2 outlets, 5-1/4-inch main valve, drain valve, and NPS 6 mechanical-joint inlet. Include interior coating according to AWWA C550. Hydrant shall have cast-iron body, compression-type valve opening against pressure and closing with pressure.
 - a. Standard: AWWA C502.
 - b. Pressure Rating: 150 psig minimum.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.
- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
- C. Do not use flanges or unions for underground piping.
- D. Flanges, unions, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.
- E. Underground water-service piping NPS 4 and NPS 6 shall be the following:
 1. NPS 4 and NPS 6: PVC, AWWA Class 150 pipe; PVC, AWWA Class 150 molded fittings; and gasketed joints.

3.3 VALVE APPLICATIONS

- A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, non-rising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 and smaller installation.
- B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Underground Valves, NPS 3 and Larger: AWWA, cast-iron, non-rising-stem, resilient-seated gate valves with valve box.
 - 2. Underground Valves, NPS 4 and Larger, for Indicator Posts: UL/FMG, cast-iron, non-rising-stem gate valves with indicator post.

3.4 PIPING INSTALLATION

- A. Water-Main Connection: Arrange with utility company for tap of size and in location indicated in water main.
- B. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.
- C. Make connections larger than NPS 2 with tapping machine according to the following:
 - 1. Install tapping sleeve and tapping valve according to MSS SP-60.
 - 2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
 - 3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
 - 4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.
- D. Comply with NFPA 24 for fire-service-main piping materials and installation.
- E. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.
- F. Bury piping with depth of cover over top at least 60 inches, with top at least 12 inches below level of maximum frost penetration.
- G. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.
 - 1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.
- H. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

- I. Make pipe joints according to the following:
 1. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.
 2. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure. Refer to Division 22 Section "Common Work Results for Plumbing" for joining piping of dissimilar metals.

3.5 ANCHORAGE INSTALLATION

- A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
 1. Concrete thrust blocks.
 2. Locking mechanical joints.
 3. Set-screw mechanical retainer glands.
 4. Bolted flanged joints.
 5. Pipe clamps and tie rods.
- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
 1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
 2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.6 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
- B. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

3.7 WATER METER INSTALLATION

- A. Install water meters, piping, and specialties according to utility company's written instructions.

3.8 FIRE HYDRANT INSTALLATION

- A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.
- B. AWWA Fire Hydrants: Comply with AWWA M17.

3.9 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. See Division 22 Section "Common Work Results for Plumbing" for piping connections to valves and equipment.
- C. Connect water-distribution piping to existing water main using tapping sleeve and tapping valve.
- D. Connect water-distribution piping to interior domestic water and fire-suppression piping.

3.10 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water. Complete tests in accordance with North Salt Lake City requirements.
- B. Prepare reports of testing activities.

3.11 IDENTIFICATION

- A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Division 31 Section "Earth Moving."
- B. Permanently attach equipment nameplate or marker indicating plastic water-service piping, on main electrical meter panel. See Division 22 Section "Common Work Results for Plumbing" for identifying devices.

3.12 CLEANING

- A. Clean and disinfect water-distribution piping as follows:
 - 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
 - 3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
 - a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.

- b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
 - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- B. Prepare reports of purging and disinfecting activities.

END OF SECTION 33 1113

SECTION 331313 – FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes gravity-flow, non-pressure sanitary sewerage outside the building, with the following components:
 - 1. Cleanouts.
 - 2. Precast concrete manholes.

1.2 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Non-pressure, Drainage-Piping Pressure Rating: 10-foot head of water.

1.3 SUBMITTALS

- A. Shop Drawings: For manholes. Include plans, elevations, sections, details, and frames and covers.
- B. Coordination Drawings: Show pipe sizes, locations, and elevations.
- C. Field quality-control test reports.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.

2.2 PVC PIPE AND FITTINGS

- A. PVC Sewer Pipe and Fittings, NPS 15 and Smaller: ASTM D 3034, SDR 35, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

2.3 NONPRESSURE-TYPE PIPE COUPLINGS

- A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground non-pressure 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 Cast-Iron Soil Pipes: ASTM C 564, rubber.
2. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
3. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

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.

1. Top-Loading Classification: Light and Heavy duty.
2. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

2.5 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 of length 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. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
8. Steps: Individual FRP steps, 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.
9. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
10. Grade Rings: Reinforced-concrete rings, 6-inch to 9-inch total thickness, to match diameter of manhole frame and cover.

11. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange and 26-inch- diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."
 - a. Material: ASTM A 48/A 48M, Class 35 gray iron, unless otherwise indicated.

2.6 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. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.
 1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
 - a. Invert Slope: 2 percent through manhole.
 2. Benches: Concrete, sloped to drain into channel.
 - a. Slope: 8 percent.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Pipe couplings and fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
 1. Use non-pressure-type flexible couplings where required to join gravity-flow, non-pressure 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.
- B. Gravity-Flow, Non-pressure Sewer Piping: Use the following pipe materials for each size range:
 - 1. NPS 5 and NPS 6: NPS 6 PVC sewer pipe and fittings, gaskets, and gasketed joints.
 - 2. NPS 8 and NPS 10: PVC sewer pipe and fittings, gaskets, and gasketed joints.

3.2 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. Install gravity-flow, non-pressure, drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow, at slope indicated.
 - 2. Install piping with 48inch minimum cover.
 - 3. Install piping below frost line.
 - 4. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
- F. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.3 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, non-pressure, drainage piping according to the following:
 - 1. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-gasket joints.
 - 2. Join dissimilar pipe materials with non-pressure-type, flexible couplings.

3.4 MANHOLE INSTALLATION

- A. General: Install manholes complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C 891.
- C. Form continuous concrete channels and benches between inlets and outlet.
- D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements.

3.5 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 light-duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
 - 2. Use heavy-duty, top-loading classification cleanouts in vehicle-traffic service areas.
- B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding grade.
- C. Set cleanout frames and covers in concrete pavement with tops flush with pavement surface.

3.6 CONNECTIONS

- A. Make connections to existing piping and underground manholes in accordance with utility company standards.

3.7 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 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.
 - 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 sewerage 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 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.
 6. Air Tests: Test sanitary sewerage 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.
- 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.

END OF SECTION 33 1313

SECTION 33 4100 – STORM UTILITY DRAINAGE PIPING

GENERAL

1.1 SUMMARY

- A. This Section includes gravity-flow, non-pressure storm drainage outside the building, with the following components:
 - 1. Cleanouts.
 - 2. Precast concrete manholes.

1.2 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Non-pressure, Drainage-Piping Pressure Rating: 10-foot head of water.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For manholes, catch basins and inlet boxes. Include sections, details, manhole frames and covers, and catch basin frames and grates.
- C. Coordination Drawings: Show pipe sizes, locations, and elevations.
- D. Field quality-control test reports. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.

2.2 HDPE PIPE AND FITTINGS

- A. Corrugated HDPE Drainage Pipe and Fittings NPS 10 and Smaller: AASHTO M 252M, Type S, with smooth waterway for coupling joints.
 - 1. Watertight Couplings: AASHTO M 252M, corrugated, matching tube and fittings.
- B. Corrugated HDPE Drainage Pipe and Fittings NPS 12 and Larger: AASHTO M 294M, Type S, with smooth waterway for coupling joints.

1. Watertight Couplings: AASHTO M 294M, corrugated, matching pipe and fittings.
- C. Perforated, HDPE Pipe and Fitting Fittings NPS 10 and Smaller: AASHTO M 252.

2.3 NONPRESSURE-TYPE PIPE COUPLINGS

- A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground non-pressure 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 Cast-Iron Soil Pipes: ASTM C 564, rubber.
 2. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 3. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- C. Unshielded Flexible Couplings: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

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.
1. Top-Loading Classification(s): Light and Heavy duty.
 2. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

2.5 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 of length 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. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
8. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
9. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
10. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange and 26-inch-diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
 - a. Material: ASTM A 48, Class 35 gray iron, unless otherwise indicated.

2.6 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.

2.7 CATCH BASINS & CLEANOUT BOXES

- A. Standard Precast Concrete Catch Basins: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
 1. 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.
 2. Top Section: Eccentric-cone type unless flat-slab-top type is indicated.
 3. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
- B. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch- diameter flat grate with small square or short-slotted drainage openings.
 1. Grate Free Area: Approximately 50 percent, unless otherwise indicated.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Pipe couplings and fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

1. Use non-pressure-type flexible couplings where required to join gravity-flow, non-pressure 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.
- B. Gravity-Flow, Non-pressure Sewer Piping: Use the following pipe materials for each size range:
 1. NPS 3 to NPS 6: Corrugated PE drainage pipe and fittings, watertight couplings, and coupled joints.
 2. NPS 8 to NPS 15: Corrugated PE drainage pipe and fittings, watertight couplings, and coupled joints.
 3. NPS 18 to NPS 30: Corrugated PE pipe and fittings, watertight couplings, and coupled joints.

3.2 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 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. Install gravity-flow, non-pressure drainage piping according to the following:
 1. Install piping pitched down in direction of flow, at slope indicated.
 2. Install piping with 24-inch minimum cover.
- F. Clear interior of piping and manholes of dirt and superfluous material as work progresses.

3.3 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 light-duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
 2. Use heavy-duty, top-loading classification cleanouts in vehicle-traffic service areas.
- B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding grade.
- C. Set cleanout frames and covers in concrete pavement with tops flush with pavement surface.

3.4 MANHOLE INSTALLATION

- A. General: Install manholes, complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C 891.
- C. Set tops of frames and covers flush with finished surface.

3.5 CATCH BASIN INSTALLATION

- A. Set frames and grates to elevations indicated.

3.6 CONNECTIONS

- A. Connect non-pressure, gravity-flow drainage piping to building's storm building drains specified in Division 22 Section "Facility Storm Drainage 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 overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

3.7 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 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.
 - 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. Air Tests: Test storm drainage 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.
- 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.

END OF SECTION 33 4100

SECTION 33 7173 - ELECTRICAL UTILITY SERVICES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes arrangement with Rocky Mountain Power for Power for permanent electric service; payment of Rocky Mountain / Salt Lake City Power charges for service; service provisions; and Rocky Mountain / Salt Lake City Power metering equipment.

1.2 SYSTEM DESCRIPTION

- A. Utility Company: Rocky Mountain Power – Pacific Corp.
- B. Service Entrance: Underground.

1.3 DESCRIPTION OF WORK:

- A. Extent of service entrance work is indicated by drawings and schedules and is specified herein.
- B. Work under this section includes the following:
 - 1. Power Company Coordination and Fees
 - 2. Power Company Transformer Pads
 - 3. Raceways and Conductors
 - 4. CT Enclosures
 - 5. Meter Centers
 - 6. Service Entrance Switchboards and/or Panel boards
 - 7. Over current Protective Devices and/or disconnects

1.4 SUBMITTALS

- A. Submittal Procedures: Shop Drawings and Product Data.
- B. Submit manufacturer's data on service entrance equipment and accessories. Submit dimensioned drawings of service entrance equipment.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with Utility Company written requirements.
- B. Maintain one copy of each document on site.

1.6 FIELD MEASUREMENTS

- A. Verify field measurements are as indicated on Drawings.

1.7 COORDINATION

- A. Coordinate with utility company, relocation of overhead or underground lines interfering with construction. Where power lines are to be relocated, bill utility costs, directly to Owner.
- B. Utility charges for service installation will be paid by Owner and are not part of this contract.

PART 2 PRODUCTS

2.1 GENERAL:

- A. Provide service entrance equipment and accessories of types, sizes, ratings, and electrical characteristics indicated or as otherwise required to provide a complete system.

2.2 METER CENTER

- A. Furnished by electrical contractor.
- B. Product Description: Free standing multi- meter center as shown on the drawings. To be NEMA 3R rated, fully bussed and rated for amperage as shown on the drawings.
- C. Meter Center must meet all requirements of the local utility company.

PART 3 EXECUTION

3.1 GENERAL:

- A. Install service entrance equipment and accessories in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 EXAMINATION

- A. Section 01300 - Administrative Requirements: Coordination and project conditions.
- B. Verify service equipment is ready to be connected and energized.
- C. Verify all ground connections have been made in accordance with NEC 250.

3.3 INSTALLATION

- A. Install service entrance conduits to building service entrance equipment. Utility Company will provide and install service lateral conductors to service entrance equipment.

- B. Install cast-in-place concrete pad or concrete vault for Utility Company transformer, in accordance with Rocky Mountain Power Co requirements.

- C. Install pre-fabricated concrete pad/vault for Utility Company transformer, in accordance with the local utility company requirements.

3.4 TRANSFORMER LOCATIONS:

- A. Verify and coordinate exact placement of concrete pad with local power company prior to installation. Strictly maintain sufficient distances from door, window, building walls and overhangs, gas meters, fuel tanks, etc. in accordance with all power company requirements. Field-verify placement of transformer pad in accordance with the local power company representative.

END OF SECTION 33 7173