
STATE OF DELAWARE
Department of Natural Resources and Environmental Control
Division of Parks and Recreation
89 Kings Highway
Dover, DE 19901
DNREC Contract No.: NAT25814-FTMILESGC

PROJECT MANUAL

ADDITION TO BATTERY 519
at
Cape Henlopen State Park
15099 Cape Henlopen Drive
Lewes, DE 19958



Prepared by

Architect/Engineer
GWWO Inc.
1215 East Fort Avenue, Suite 24
Baltimore MD 21230

Issued for Bid
April 30, 2025

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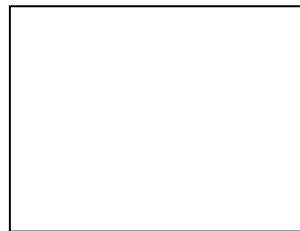
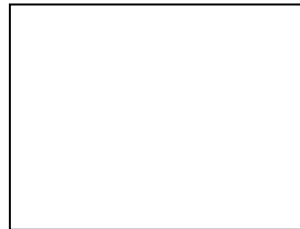
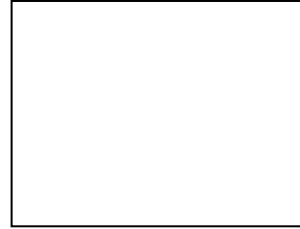
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SECTION 00 01 07 – SEALS PAGE

1.1 DESIGN PROFESSIONAL OF RECORD

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END OF SECTION 00 01 07

Specifications for this project are arranged in accordance with the Construction Specification Institute numbering system and format. Section numbering is discontinuous and all numbers not appearing in the Table of Contents are not used for this Project.

DOCUMENTS BOUND HEREWITH

Division	Section Title	Pages
DIVISION 00 - PROCUREMENT AND CONTRACT REQUIREMENTS		

INTRODUCTORY INFORMATION

00 01 01	PROJECT TITLE PAGE
00 01 07	SEALS PAGE
00 01 10	TABLE OF CONTENTS
00 01 15	LIST OF DRAWING SHEETS

PROCUREMENT REQUIREMENTS

00 11 16	INVITATION TO BID
00 21 13	INSTRUCTIONS TO BIDDERS
00 41 13	BID FORM
00 43 13	BID BOND

CONTRACTING REQUIRMENTS

00 52 13	STANDARD FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR A101-2017
	SAMPLE AIA A101-2017
00 54 13	SUPPLEMENT TO AGREEMENT BETWEEN OWNER AND CONTRACTOR AIA A101-2017
00 54 14	SUPPLEMENT TO A101-2017 – EXHIBIT A – INSURANCE & BONDS
00 61 13.13	PERFORMANCE BOND
00 61 13.16	PAYMENT BOND
00 62 76	APPLICATION OF PAYMENT & CERTIFICATION FORMS
	SAMPLE AIA G702 & G703
00 72 13	GENERAL CONDITIONS TO THE CONTRACT, AIA A201, 2017
00 73 13	SUPPLEMENTARY GENERAL CONDITIONS
00 73 43	DELAWARE DEPARTMENT OF LABOR PREVAILING WAGE RATES
	CERTIFIED WAGE RATES
00 81 13	GENERAL REQUIREMENTS
00 81 14	DRUG TESTING FORMS
00 81 15	AFFIDAVIT OF CRAFT TRAINING COMPLIANCE

DIVISION 1 - GENERAL REQUIREMENTS

01 10 00	SUMMARY
01 14 00	WORK RESTRICTIONS
01 21 00	ALLOWANCES

01 22 00	UNIT PRICES
01 24 00	PERMITS
01 26 00	CONTRACT MODIFICATION PROCEDURES
01 29 00	PAYMENT PROCEDURES
01 31 00	PROJECT MANAGEMENT AND COORDINATION
01 31 50	FIELD ENGINEERING
01 32 00	CONSTRUCTION PROGRESS DOCUMENTATION
01 32 33	PHOTOGRAPHIC DOCUMENTATION
01 33 00	SUBMITTAL PROCEDURES
01 40 00	QUALITY REQUIREMENTS
01 42 00	REFERENCE STANDARDS AND DEFINITIONS
01 50 00	TEMPORARY FACILITIES AND CONTROLS
01 56 00	ENVIRONMENTAL PROTECTION
01 56 39	TEMPORARY TREE AND PLANT PROTECTION
01 60 00	PRODUCT REQUIREMENTS
01 73 00	EXECUTION REQUIREMENTS
01 73 29	CUTTING AND PATCHING
01 74 19	CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
01 77 00	CLOSEOUT PROCEDURES
01 78 23	OPERATION AND MAINTENANCE DATA
01 78 39	PROJECT RECORD DOCUMENTS
01 79 00	DEMONSTRATION AND TRAINING

DIVISION 2 – EXISTING CONDITIONS

02 32 00	GEOTECHNICAL INVESTIGATION
02 41 00	SELECTIVE DEMOLITION

DIVISION 3 - CONCRETE

03 01 00	MAINTENANCE OF CONCRETE
03 20 00	CONCRETE REINFORCING
03 30 00	CAST IN PLACE CONCRETE

DIVISION 4 – MASONRY

04 20 00	UNIT MASONRY
04 72 00	CAST STONE MASONRY

DIVISION 5 - METALS

05 12 00	STRUCTURAL STEEL
05 12 13	ARCHITECTURALLY-EXPOSED STRUCTURAL STEEL
05 31 00	STEEL DECKING
05 40 00	COLD-FORMED METAL FRAMING
05 50 00	METAL FABRICATIONS
05 51 00	METAL STAIRS
05 52 13	PIPE AND TUBE RAILINGS

DIVISION 6 – WOOD, PLASTICS AND COMPOSITES

- 06 10 00 ROUGH CARPENTRY
- 06 41 00 ARCHITECTURAL WOOD CASEWORK

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

- 07 13 00 SHEET WATERPROOFING
- 07 21 00 THERMAL INSULATION
- 07 27 00 AIR BARRIERS
- 07 33 63 VEGETATED ROOF ASSEMBLY: PRE-VEGETATED MODULAR
- 07 42 13.23 METAL COMPOSITE MATERIAL WALL PANELS
- 07 54 00 THERMOPLASTIC MEMBRANE ROOFING
- 07 62 00 SHEET METAL FLASHING AND TRIM
- 07 84 00 FIRESTOPPING
- 07 92 00 JOINT SEALANTS

DIVISION 8 - OPENINGS

- 08 06 71 DOOR HARDWARE SCHEDULE
- 08 12 14 TRIMLESS DOOR FRAMES
- 08 14 16 FLUSH WOOD DOORS
- 08 16 13 FIBERGLASS FRAMES
- 08 31 00 ACCESS DOORS AND PANELS
- 08 43 13 ALUMINUM-FRAMED STOREFRONTS
- 08 44 13 GLAZED ALUMINUM CURTAIN WALLS
- 08 71 00 DOOR HARDWARE
- 08 80 00 GLAZING
- 08 91 00 LOUVERS

DIVISION 9 - FINISHES

- 09 21 16 GYPSUM BOARD ASSEMBLIES
- 09 22 16 NON-STRUCTURAL METAL FRAMING
- 09 30 00 TILING
- 09 51 00 ACOUSTICAL CEILINGS
- 09 65 00 RESILIENT FLOORING
- 09 67 00 FLUID-APPLIED FLOORING
- 09 68 13 TILE CARPETING
- 09 91 23 INTERIOR PAINTING
- 09 96 72 FLUID-APPLIED INSULATION COATING

DIVISION 10 - SPECIALTIES

- 10 14 19 DIMENSIONAL LETTER SIGNAGE
- 10 14 23 PANEL SIGNAGE
- 10 28 00 TOILET, BATH, AND LAUNDRY ACCESSORIES

10 28 13 MISCELLANEOUS SPECIALTIES
10 44 00 FIRE PROTECTION SPECIALTIES

DIVISION 11 – EQUIPMENT – (NOT USED)

DIVISION 12 - FURNISHINGS

12 48 13 ENTRANCE FLOOR MATS AND FRAMES

DIVISIONS 13 THRU 21 – (NOT USED)

DIVISION 22 - PLUMBING

22 05 00 COMMON WORK RESULTS FOR PLUMBING
22 05 23 GENERAL DUTY VALVES FOR PLUMBING PIPING
22 05 29 HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT
22 05 48 VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT
22 05 53 IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT
22 05 93 TESTING, ADJUSTING AND BALANCING FOR PLUMBING
22 07 19 PLUMBING PIPING INSULATION
22 11 13 FACILITY WATER DISTRIBUTION PIPING
22 11 16 DOMESTIC WATER PIPING
22 11 19 DOMESTIC-WATER PIPING SPECIALTIES
22 11 23.13 DOMESTIC-WATER PACKAGED BOOSTER PUMPS
22 11 23.21 INLINE, DOMESTIC-WATER PUMPS
22 13 13 FACILITY SANITARY SEWERS
22 13 16 SANITARY WASTE AND VENT PIPING
22 13 19 SANITARY WASTE PIPING SPECIALTIES
22 13 19.13 SANITARY DRAINS
22 14 14 STORM DRAINAGE PIPING
22 14 23 STORM DRAINAGE PIPING SPECIALITIES
22 14 29 SUMP PUMPS
22 33 00 ELECTRIC DOMESTIC-WATER HEATERS
22 42 00 COMMERCIAL PLUMBING FIXTURES
22 47 00 DRINKING FOUNTAINS AND WATER COOLERS

DIVISION 23 – HEATING, VENTILATING AND AIR CONDITIONING

23 05 00 COMMON WORK RESULTS FOR HVAC
23 05 29 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
23 05 48 VIBRATION CONTROLS FOR HVAC
23 05 53 IDENTIFICATION FOR HVAC PIPING, DUCTWORK AND EQUIPMENT
23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC
23 07 13 DUCT INSULATION
23 07 19 HVAC PIPING INSULATION
23 23 00 REFRIGERANT PIPING

23 31 13	METAL DUCTS
23 33 00	AIR DUCT ACCESSORIES
23 33 46	FLEXIBLE DUCTS
23 37 13.13	AIR DIFFUSERS
23 37 13.23	REGISTERS AND GRILLES
23 72 23.19	PACKAGED INDOOR FIXED PLATE ENERGY RECOVERY UNITS
23 81 29	VARIABLE REFRIGERANT FLOW HVAC SYSTEM
23 82 39.16	PROPELLER UNIT HEATERS

DIVISION 26 – ELECTRICAL

26 00 50	COMMON WORK RESULTS FOR ELECTRICAL
26 05 19	LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
26 05 26	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
26 05 29	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
26 05 33	RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
26 05 43	UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS
26 05 44	SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING
26 05 53	IDENTIFICATION FOR ELECTRICAL SYSTEMS
26 09 23	LIGHTING CONTROL DEVICES
26 24 16	PANELBOARDS
26 27 26	WIRING DEVICES
26 28 13	FUSES
26 28 16	ENCLOSED SWITCHES AND CIRCUIT BREAKERS
26 51 19	LED INTERIOR LIGHTING
26 52 13	EMERGENCY AND EXIT LIGHTING

DIVISION 27 – COMMUNICATIONS – (NOT USED)

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

28 05 14	FIRE ALARM CABLES AND CONDUCTORS
28 46 21	ADDRESSABLE FIRE ALARM SYSTEM WITH ONE-WAY EMERGENCY VOICE ALARM COMMUNICATIONS SYSTEM
28 48 13	EMERGENCY RESPONDER COMMUNICATIONS ENHANCEMENT SYSTEM (ERCES)

DIVISION 31 – EARTHWORK

31 10 00	SITE CLEARING
31 20 00	EARTH MOVING
31 23 23	FILL
31 23 23.43	(EPS)GEOFOAM

DIVISION 32 – EXTERIOR IMPROVEMENTS

32 13 13	CONCRETE PAVING

32 14 00 UNIT PAVING
32 93 00 PLANTING

DIVISION 33 – UTILITIES

33 42 00 STORMWATER CONVEYANCE

END OF TABLE OF CONTENTS

SECTION 00 01 15 - LIST OF DRAWINGS

<u>Sheet No.</u>	<u>Title</u>
CS.1	Cover Sheet
CS.2	Abbreviations, Keynotes & Symbols
CS.3	Code Study
CS.4	Overall Egress Plan
CS.5	Enlarged Egress Plan – Area A
C301	General Notes
C302	Legend
C303	Demolition Plan
C304	Overall Site Plan
C305	Site Plan
C306	Sanitary and Water Lateral Profiles
C307	Storm Drain Profile
C308	Construction Details
FM101	Fire Marshal Site Plan
SW100	Sediment & Erosion Control Cover Sheet
SW101	Pre-Construction Site Plan
SW102	Post-Construction Site Plan
SW103	Erosion and Sediment Control Details
SW104	Erosion and Sediment Control Details
SW105	Erosion and Sediment Control Details
SW106	Erosion and Sediment Control Details
L100	Layout & Grading Plan & Details
L500	Tree Protection & Planting, Details & Notes
AS.1	Architectural Site Plan
AR.1	Architectural Reference Plan
AC.1	Construction Types
AC.2	Typical Details
AD.1	Demolition Plan – Area A
AD.2	Demolition Plan – Area B
AD.3	Demolition Plan – Area C
AD.4	Demolition Plan – Area D
AD.5	Demolition Reflected Ceiling Plan – Area C
A1.1	Floor Plan – Area A
A1.2	Floor Plan – Area B
A1.3	Floor Plan – Area C
A1.4	Floor Plan – Area D
A1.5	Roof Plan – Area A
A2.1	Reflected Ceiling Plan – Area A
A2.2	Reflected Ceiling Plan – Area C

A3.1	Exterior Elevations
A4.1	Building Sections
A4.2	Wall Sections
A6.1	Plan Details
A6.2	Plan Details
A6.3	Section Details
A6.4	Section Details
A6.5	Section Details
A6.6	Section Details
A6.7	Section & Stair Details
A7.1	Interior Elevations & Reception Desk
A7.2	Enlarged Restroom Plans & Interior Elevations
A7.3	Interior Elevations
A8.1	Door Schedule
A8.2	Window & Louver Schedule
A9.1	Finish Plan – Area A and Details
A9.2	Finish Plan – Area C
S0.0	Structural Notes
S0.1	Structural Notes
S1.0	Foundation Plans
S1.1	Framing Plans
S5.0	Foundation Details
S5.1	Foundation Details
S5.2	Foundation Details
S5.3	Framing Details
S5.4	Framing Details
S6.0	Structural Schedules
S6.1	Structural SI Schedules
M0.1	Mechanical Cover Sheet
M1.1	First Floor – Ductwork
M2.1	First Floor – Mechanical Piping
M4.1	Mechanical Sections
M5.1	Mechanical Details
M6.1	Automatic Temperature Controls
M7.1	Mechanical Schedules
P0.1	Plumbing Cover Sheet
P0.2	Plumbing Site Plan
P1.0	Foundation – Plumbing Plan
P1.1	First Floor – Plumbing
P1.2	Roof – Plumbing Plan
P5.1	Plumbing Details
P6.1	Plumbing Riser Diagrams
P7.1	Plumbing Schedules
E0.1	Electrical Cover Sheet

E0.2	Electrical Cover Sheet
E0.3	Electrical Site Plan
ED1.1	First Floor – Area A – Lighting – Demolition
ED1.2	Conference Room 110 Part Plan – Lighting - Demolition
E1.1	First Floor – Area A – Lighting – New Work
E1.2	First Floor – Area A – Electrical – New Work
E1.3	First Floor – Area B – Electrical – New Work
E1.4	First Floor – Area C – Lighting – New Work
E1.5	First Floor – Area D – Lighting – New Work
E2.1	First Floor – Area A – Power and Communications – New Work
E4.1	Conference Room 110 Part Plan – Lighting – New Work
E5.1	Electrical Details
E5.2	Electrical Details
E6.1	Electrical One-Line Diagram
E7.1	Lighting Control Diagrams
E8.1	Luminaire Schedule
E8.2	Electrical Schedules
FA0.1	Fire Alarm Cover Sheet
FA0.2	Fire Alarm Overall Building Plan
FA1.1	First Floor Plan – Area A – Fire Alarm – New Work
FA1.2	First Floor Plan – Area B – Fire Alarm – New Work
FA1.3	First Floor Plan – Area C – Fire Alarm – New Work
FA1.4	First Floor Plan – Area D – Fire Alarm – New Work
FA7.1	Fire Alarm Matrix and Schedules

END OF SECTION 00 01 15

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SECTION 00 11 16

INVITATION TO BID

Sealed bids for **DNREC Contract No. NAT25814-FTMILESGC**, will be received by the State of Delaware, DNREC, Division of Parks and Recreation at 89 Kings Highway, Dover DE 19901 until **1:00 PM** local time on **Thursday, June 5, 2025**. The bids will be opened and read aloud live at **1:00 PM** local time on **Thursday, June 5, 2025**, via an online video conference with an option to call in using a telephone. The bid opening will not be held in-person. To attend the bid opening, the public may join via Microsoft Teams enabled computer or mobile app, using Teams Meeting ID: **217 129 337 435 9** and Passcode: **"QC2Vp6SR"**. Audio-only, conference call type of participation is available by calling 1-302-504-8986 and using ID: **"690 092 665#"**.

Project involves the construction of a building addition to the Fort Miles Museum in Battery 519. The addition contains a lobby, restrooms and an office. Site utility work includes bringing power, water and sanitary to the addition. Site improvements include landscaping, concrete and paving. Work within Battery 519 includes changes to doors, providing new walls and doors, and fire alarm installation throughout.

A MANDATORY Pre-Bid Meeting will be held on **Wednesday, May 21, 2025**, at **1:00 PM** at Cape Henlopen State Park – Battery 519, 15462 Battery Road, Lewes, DE 19958 (Follow signs for Fort Miles, park in the lower museum parking lot) for the purpose of establishing the listing of subcontractors and to answer questions. Representatives of each party to any Joint Venture must attend this meeting. **ATTENDANCE OF THIS MEETING IS A PREREQUISITE FOR BIDDING ON THIS CONTRACT.**

Sealed bids shall be addressed to the DNREC - Division of Parks and Recreation, 89 Kings Highway, Dover, DE 19901. The outer envelope should clearly indicate: **"DNREC CONTRACT NO. NAT25814-FTMILESGC - SEALED BID - DO NOT OPEN."** We are also accepting, and prefer, emailed bids. They must be emailed to Shawn.Heacock@delaware.gov and Kevin.Rychlicki@delaware.gov prior to the bid deadline. Bidder bears the risk of late delivery regardless of submission method. Any bids received after the deadline will be rejected.

Contract documents shall be obtained by using the online form located at <https://bit.ly/2TVIu2z> and filling in the required fields. Once the information is provided, bid documents will be sent by email using Egress Switch (State's secure email drop-box type of system). The documents will be e-mailed at no cost.

Bidders will not be subject to discrimination on the basis of race, creed, color, sex, sexual orientation, gender identity or national origin in consideration of this award, and Minority Business Enterprises, Disadvantaged Business Enterprises, Women-Owned Business Enterprises and Veteran-Owned Business Enterprises will be afforded full opportunity to submit bids on this contract. Each bid must be accompanied by a bid security equivalent to ten percent of the bid amount and all additive alternates. The successful bidder must post a performance bond and payment bond in a sum equal to 100 percent of the contract price upon execution of the contract. The Owner reserves the right to reject any or all bids and to waive any informalities therein. The Owner may extend the time and place for the opening of the bids from that described in the advertisement, with not less than two calendar days' notice by e-mail to those bidders receiving plans.

Gregory Patterson, Secretary

END OF SECTION 00 11 16

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SECTION 00 21 13

INSTRUCTIONS TO BIDDERS

TABLE OF ARTICLES

1. GENERAL
2. BIDDER'S REPRESENTATION
3. BIDDING DOCUMENTS
4. BIDDING PROCEDURES
5. CONSIDERATION OF BIDS
6. POST-BID INFORMATION
7. PERFORMANCE BOND AND PAYMENT BOND
8. FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR

ARTICLE 1: GENERAL

1.1 DEFINITIONS

1.1.1 Whenever the following terms are used, their intent and meaning shall be interpreted as follows:

1.2 STATE: The State of Delaware.

1.3 AGENCY: Contracting State Agency as noted on cover sheet.

1.4 DESIGNATED OFFICIAL: The agent authorized to act for the Agency.

1.5 BIDDING DOCUMENTS: Bidding Documents include the Bidding Requirements and the proposed Contract Documents. The Bidding Requirements consist of the Advertisement for Bid, Invitation to Bid, Instructions to Bidders, Supplementary Instructions to Bidders (if any), General Conditions, Supplementary General Conditions, General Requirements, Special Provisions (if any), the Bid Form (including the Non-collusion Statement), and other sample bidding and contract forms. The proposed Contract Documents consist of the form of Agreement between the Owner and Contractor, as well as the Drawings, Specifications (Project Manual) and all Addenda issued prior to execution of the Contract.

1.6 CONTRACT DOCUMENTS: The Contract Documents consist of the, Instructions to Bidders, Supplementary Instructions to Bidders (if any), General Conditions, Supplementary General Conditions, General Requirements, Special Provisions (if any), the form of agreement between the Owner and the Contractor, Drawings (if any), Specifications (Project Manual), and all addenda.

1.7 AGREEMENT: The form of the Agreement shall be AIA Document A101, Standard Form of Agreement between Owner and Contractor where the basis of payment is a STIPULATED SUM. In the case of conflict between the instructions contained therein and the General Requirements herein, these General Requirements shall prevail.

1.8 GENERAL REQUIREMENTS (or CONDITIONS): General Requirements (or conditions) are instructions pertaining to the Bidding Documents and to contracts in general. They contain, in summary, requirements of laws of the State; policies of the Agency and instructions to bidders.

1.9 SPECIAL PROVISIONS: Special Provisions are specific conditions or requirements peculiar to the bidding documents and to the contract under consideration and are supplemental to the General Requirements. Should the Special Provisions conflict with the General Requirements, the Special Provisions shall prevail.

1.10 ADDENDA: Written or graphic instruments issued by the Owner/Architect prior to the execution of the contract which modify or interpret the Bidding Documents by additions, deletions, clarifications or corrections.

- 1.11 BIDDER OR VENDOR: A person or entity who formally submits a Bid for the material or Work contemplated, acting directly or through a duly authorized representative who meets the requirements set forth in the Bidding Documents.
- 1.12 SUB-BIDDER: A person or entity who submits a Bid to a Bidder for materials or labor, or both for a portion of the Work.
- 1.13 BID: A complete and properly executed proposal to do the Work for the sums stipulated therein, submitted in accordance with the Bidding Documents.
- 1.14 BASE BID: The sum stated in the Bid for which the Bidder offers to perform the Work described in the Bidding Documents as the base, to which Work may be added or from which Work may be deleted for sums stated in Alternate Bids (if any are required to be stated in the bid).
- 1.15 ALTERNATE BID (or ALTERNATE): An amount stated in the Bid, where applicable, to be added to or deducted from the amount of the Base Bid if the corresponding change in the Work, as described in the Bidding Documents is accepted.
- 1.16 UNIT PRICE: An amount stated in the Bid, where applicable, as a price per unit of measurement for materials, equipment or services or a portion of the Work as described in the Bidding Documents.
- 1.17 SURETY: The corporate body which is bound with and for the Contract, or which is liable, and which engages to be responsible for the Contractor's payments of all debts pertaining to and for his acceptable performance of the Work for which he has contracted.
- 1.18 BIDDER'S DEPOSIT: The security designated in the Bid to be furnished by the Bidder as a guaranty of good faith to enter into a contract with the Agency if the Work to be performed or the material or equipment to be furnished is awarded to him.
- 1.19 CONTRACT: The written agreement covering the furnishing and delivery of material or work to be performed.
- 1.20 CONTRACTOR: Any individual, firm or corporation with whom a contract is made by the Agency.
- 1.21 SUBCONTRACTOR: An individual, partnership or corporation which has a direct contract with a contractor to furnish labor and materials at the job site, or to perform construction labor and furnish material in connection with such labor at the job site.
- 1.22 CONTRACT BOND: The approved form of security furnished by the contractor and his surety as a guaranty of good faith on the part of the contractor to execute the work in accordance with the terms of the contract.
- 1.23 CUSTOM FABRICATION: As defined in 29 Del. C. § 6902, the term "custom fabrication" means the offsite fabrication, assembly, or other production of non-standard goods or materials, including components, fixtures or parts thereof, specifically for a public works project. Such goods and materials shall include those used in the following trades or

systems: (1) Plumbing or pipe fitting systems, including heating, ventilating, air-conditioning, refrigeration systems, sheet metal or other duct systems; (2) Electrical systems; (3) Mechanical insulation work; (4) Ornamental iron work; and (5) Commercial signage that does not attempt or appear to direct the movement of traffic on highways or roadways or interfere with, imitate, or resemble any official traffic sign, signal or device.

ARTICLE 2: BIDDER'S REPRESENTATION

2.1 PRE-BID MEETING

2.1.1 A pre-bid meeting for this project will be held at the time and place designated. Attendance at this meeting is a pre-requisite for submitting a Bid, unless this requirement is specifically waived elsewhere in the Bid Documents.

2.2 By submitting a Bid, the Bidder represents that:

2.2.1 The Bidder has read and understands the Bidding Documents and that the Bid is made in accordance therewith.

2.2.2 The Bidder has visited the site, become familiar with existing conditions under which the Work is to be performed, and has correlated the Bidder's personal observations with the requirements of the proposed Contract Documents.

2.2.3 The Bid is based upon the materials, equipment, and systems required by the Bidding Documents without exception.

2.3 JOINT VENTURE REQUIREMENTS

2.3.1 For Public Works Contracts, each Joint Venturer shall be qualified and capable to complete the Work with their own forces.

2.3.2 Included with the Bid submission, and as a requirement to bid, a copy of the executed Joint Venture Agreement shall be submitted and signed by all Joint Venturers involved.

2.3.3 All required Bid Bonds, Performance Bonds, Material and Labor Payment Bonds must be executed by both Joint Venturers and be placed in both of their names.

2.3.4 All required insurance certificates shall name both Joint Venturers.

2.3.5 Both Joint Venturers shall sign the Bid Form.

2.3.6 Both Joint Venturers shall include their Federal E.I. Number with the Bid.

2.3.7 In the event of a mandatory Pre-bid Meeting, each Joint Venturer shall have a representative in attendance.

2.3.8 Due to exceptional circumstances and for good cause shown, one or more of these provisions may be waived at the discretion of the State.

2.4 ASSIGNMENT OF ANTITRUST CLAIMS

- 2.4.1 As consideration for the award and execution by the Owner of this contract, the Contractor hereby grants, conveys, sells, assigns and transfers to the State of Delaware all of its right, title and interests in and to all known or unknown causes of action it presently has or may now or hereafter acquire under the antitrust laws of the United States and the State of Delaware, relating to the particular goods or services purchased or acquired by the Owner pursuant to this contract.

ARTICLE 3: BIDDING DOCUMENTS

3.1 COPIES OF BID DOCUMENTS

- 3.1.1 Bidders may obtain complete sets of the Bidding Documents from the Architectural/Engineering firm designated in the Advertisement or Invitation to Bid in the number and for the deposit sum, if any, stated therein.
- 3.1.2 Bidders shall use complete sets of Bidding Documents for preparation of Bids. The issuing Agency nor the Architect assumes no responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.
- 3.1.3 Any errors, inconsistencies or omissions discovered shall be reported to the Architect immediately.
- 3.1.4 The Agency and Architect may make copies of the Bidding Documents available on the above terms for the purpose of obtaining Bids on the Work. No license or grant of use is conferred by issuance of copies of the Bidding Documents.

3.2 INTERPRETATION OR CORRECTION OF BIDDING DOCUMENTS

- 3.2.1 The Bidder shall carefully study and compare the Bidding Documents with each other, and with other work being bid concurrently or presently under construction to the extent that it relates to the Work for which the Bid is submitted, shall examine the site and local conditions, and shall report any errors, inconsistencies, or ambiguities discovered to the Architect.
- 3.2.2 Bidders or Sub-bidders requiring clarification or interpretation of the Bidding Documents shall make a written request to the Architect at least seven days prior to the date for receipt of Bids. Interpretations, corrections and changes to the Bidding Documents will be made by written Addendum. Interpretations, corrections, or changes to the Bidding Documents made in any other manner shall not be binding.
- 3.2.3 The apparent silence of the specifications as to any detail, or the apparent omission from it of detailed description concerning any point, shall be regarded as meaning that only the best commercial practice is to prevail and only material and workmanship of the first quality are to be used. Proof of specification compliance will be the responsibility of the Bidder.

3.2.4 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for all permits, labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for the proper execution and completion of the Work.

3.2.5 The Owner will bear the costs for all impact and user fees associated with the project.

3.3 SUBSTITUTIONS

3.3.1 The materials, products and equipment described in the Bidding Documents establish a standard of quality, required function, dimension, and appearance to be met by any proposed substitution. The specification of a particular manufacturer or model number is not intended to be proprietary in any way. Substitutions of products for those named will be considered, providing that the Vendor certifies that the function, quality, and performance characteristics of the material offered is equal or superior to that specified. It shall be the Bidder's responsibility to assure that the proposed substitution will not affect the intent of the design, and to make any installation modifications required to accommodate the substitution.

3.3.2 Requests for substitutions shall be made in writing to the Architect at least ten days prior to the date of the Bid Opening. Such requests shall include a complete description of the proposed substitution, drawings, performance and test data, explanation of required installation modifications due the substitution, and any other information necessary for an evaluation. The burden of proof of the merit of the proposed substitution is upon the proposer. The Architect's decision of approval or disapproval shall be final. The Architect is to notify Owner prior to any approvals.

3.3.3 If the Architect approves a substitution prior to the receipt of Bids, such approval shall be set forth in an Addendum. Approvals made in any other manner shall not be binding.

3.3.4 The Architect shall have no obligation to consider any substitutions after the Contract award.

3.4 ADDENDA

3.4.1 Addenda will be mailed or delivered to all who are known by the Architect to have received a complete set of the Bidding Documents.

3.4.2 Copies of Addenda will be made available for inspection wherever Bidding Documents are on file for that purpose.

3.4.3 No Addenda will be issued later than 2 calendar days prior to the date for receipt of Bids except an Addendum withdrawing the request for Bids or one which extends the time or changes the location for the opening of bids.

3.4.4 Each bidder shall ascertain prior to submitting his Bid that they have received all Addenda issued, and shall acknowledge their receipt in their Bid in the appropriate space. Not acknowledging an issued Addenda could be grounds for determining a bid to be non-responsive.

ARTICLE 4: BIDDING PROCEDURES

4.1 PREPARATION OF BIDS

- 4.1.1 Submit the bids on the Bid Forms included with the Bidding Documents.
- 4.1.2 Submit the original Bid Form for each bid. Bid Forms may be removed from the project manual for this purpose.
- 4.1.3 Execute all blanks on the Bid Form in a non-erasable medium (typewriter or manually in ink).
- 4.1.4 Where so indicated by the makeup on the Bid Form, express sums in both words and figures, in case of discrepancy between the two, the written amount shall govern.
- 4.1.5 Interlineations, alterations or erasures must be initialed by the signer of the Bid.
- 4.1.6 **BID ALL REQUESTED ALTERNATES AND UNIT PRICES, IF ANY.** If there is no change in the Base Bid for an Alternate, enter “No Change”. The Contractor is responsible for verifying that they have received all addenda issued during the bidding period. Work required by Addenda shall automatically become part of the Contract.
- 4.1.7 Make no additional stipulations on the Bid Form and do not qualify the Bid in any other manner.
- 4.1.8 Each copy of the Bid shall include the legal name of the Bidder and a statement whether the Bidder is a sole proprietor, a partnership, a corporation, or any legal entity, and each copy shall be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid by a corporation shall further give 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 agent's authority to bind the Bidder.
- 4.1.9 Bidder shall complete the Non-Collusion Statement form included with the Bid Forms and include it with their Bid.
- 4.1.10 In the construction of all Public Works projects for the State of Delaware or any agency thereof, preference in employment of laborers, workers or mechanics shall be given to bona fide legal citizens of the State who have established citizenship by residence of at least 90 days in the State.
- 4.1.11 Each bidder shall include a signed Affidavit for the Bidder certifying compliance with OMB Regulation 4104 - “Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on “Large Public Works Projects.” “Large Public Works” is based upon the current threshold required for bidding Public Works as set by the Purchasing and Contracting Advisory Council.

4.2 BID SECURITY

- 4.2.1 All bids shall be accompanied by a deposit of either a good and sufficient bond to the agency for the benefit of the agency, with corporate surety authorized to do business in this State, the form of the bond and the surety to be approved by the agency, or a security of the bidder assigned to the agency, for a sum equal to at least 10% of the bid plus all add alternates, or in lieu of the bid bond a security deposit in the form of a certified check, bank treasurer's check, cashier's check, money order, or other prior approved secured deposit assigned to the State. The bid bond need not be for a specific sum, but may be stated to be for a sum equal to 10% of the bid plus all add alternates to which it relates and not to exceed a certain stated sum, if said sum is equal to at least 10% of the bid. The Bid Bond form used shall be the standard OMB form (attached).
- 4.2.2 The Agency has the right to retain the bid security of Bidders to whom an award is being considered until either a formal contract has been executed and bonds have been furnished or the specified time has elapsed so the Bids may be withdrawn or all Bids have been rejected.
- 4.2.3 In the event of any successful Bidder refusing or neglecting to execute a formal contract and bond within 20 days of the awarding of the contract, the bid bond or security deposited by the successful bidder shall be forfeited.
- 4.3 SUBCONTRACTOR LIST
- 4.3.1 In accordance with Title 29, Chapter 69, Section 6962(d)(10)b of the Delaware Code, each Bidder shall submit with their Bid a completed List of Sub-Contractors included with the Bid Form. NAME ONLY ONE SUBCONTRACTOR FOR EACH TRADE. The bidder must list **in each category** the full name and address (City & State) of the subcontractor that the Bidder will be using to perform the work and provide material for that subcontractor category. Should the Bidder's listed subcontractor intend to provide any of their subcontractor category of work through a third-tier contractor, the Bidder shall list that third-tier contractor's full name and address (City & State). **If the Bidder intends to perform any category of work itself, it must list its full name and address.** For clarification, if the Bidder intends to perform the work themselves, the Bidder **may not** insert "not applicable", "N/A", "self" or anything other than its own full name and address (City & State). To do so shall cause the bid to be rejected. In addition, the failure to produce a completed subcontractor list with the bid submittal shall cause the bid to be rejected. If you have more than three (3) third-tier contractors to report in any subcontractor category, print out additional page(s) containing the appropriate category, complete the rest of your list of third-tier contractors for that category, notate the addition in parentheses as (CONTINUATION) next to the subcontractor category and an asterisk (*) next to any additional third-tier contractors, and submit it with your bid.
- 4.3.2 It is the responsibility of the Contractor to ensure that their Subcontractors are in compliance with the provisions of this law. Also, if a Contractor elects to list themselves as a Subcontractor for any category, they must specifically name themselves on the Bid Form and be able to document their capability to act as Subcontractor in that category in accordance with this law.
- 4.4 AFFIDAVIT OF CONTRACTOR QUALIFICATIONS

- 4.4.1 In accordance with Title 29, Chapter 69, Section 6962(d)(10)b.3 of the Delaware Code, each Bidder shall submit with their Bid the Affidavit of Contractor Qualifications certifying that the Bidder will abide by the contractor's qualifications outlined in the construction bid specifications for the duration of the contract term. After a contract has been awarded the successful bidder shall not substitute another subcontractor whose name was submitted on the Subcontractor Form except for the reasons in the statute and not without written consent from the awarding agency. Failure to utilize the subcontractors on the list will subject the successful bidder to penalties as outlined in the General Requirements Section 5.2 of the contract.

4.5 AFFIDAVIT OF CRAFT TRAINING COMPLIANCE

- 4.5.1 In accordance with Title 29, Chapter 69, Section 6962(c)(13) of the Delaware Code, contractors and subcontractors must provide craft training for journeyman and apprentice levels if **all** of the following apply:

- A. A project meets the prevailing wage requirement under Title 29, Chapter 69, Section 6960 of the Delaware Code.
- B. The contractor employs 10 or more total employees.
- C. The project is not a federal highway project

Failure to provide required craft training on the project may subject the successful contractor and/or subcontractor(s) to penalties as outlined in Title 29, Chapter 69, Section 6962(c)(13) of the Delaware Code.

Bidders shall submit the Affidavit of Craft Training Compliance prior to contract execution.

4.6 EQUALITY OF EMPLOYMENT OPPORTUNITY ON PUBLIC WORKS

- 4.6.1 During the performance of this contract, the contractor agrees as follows:

- A. The Contractor will not discriminate against any employee or applicant for employment because of race, creed, sex, color, sexual orientation, gender identity or national origin. The Contractor will take affirmative action to ensure the applicants are employed, and that employees are treated during employment, without regard to their race, creed, sex, color, sexual orientation, gender identity or national origin. Such action shall include, but not be limited to, the following: Employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places available to employees and applicants for employment notices to be provided by the contracting agency setting forth this nondiscrimination clause.
- B. The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive

consideration for employment without regard to race, creed, sex, color, sexual orientation, gender identity or national origin."

4.7 PREVAILING WAGE REQUIREMENT

4.7.1 Wage Provisions: For renovation and new construction projects whose costs exceed the thresholds contained in Delaware Code, Title 29, Section 6960, the minimum wage rates for various classes of laborers and mechanics shall be as determined by the Department of Labor, Division of Industrial Affairs of the State of Delaware.

4.7.2 The employer shall pay all mechanics and labors employed directly upon the site of work, or engaged in custom fabrication work, as that term is defined in Article 1.23 herein and as also as defined in 29 Del. C. § 6902 and described in 29 Del. C. § 6960(b), regardless of where the work is performed, unconditionally and not less often than once a week and without subsequent deduction or rebate on any account, the full amounts accrued at time of payment, computed at wage rates not less than those stated in the specifications, regardless of any contractual relationship which may be alleged to exist between the employer and such laborers and mechanics.

4.7.3 As per 29 Del. C. § 6960(b), the scale of the wages to be paid must be posted by the employer in a prominent and easily accessible place at the site of the work. There may be withheld from the employer so much of accrued payments as may be considered necessary by the Department of Labor to pay laborers and mechanics employed by the employer the difference between the rates of wages required by the contract to be paid laborers and mechanics on the work and rates of wages received by such laborers and mechanics to be remitted to the Department of Labor for distribution upon resolution of any claims.

4.7.4 Every contract based upon these specifications shall contain a stipulation that sworn payroll information, as required by the Department of Labor, be furnished weekly. The Department of Labor shall keep and maintain the sworn payroll information for a period of 6 months from the last day of the work week covered by the payroll.

4.8 SUBMISSION OF BIDS

4.8.1 Enclose the Bid, the Bid Security, and any other documents required to be submitted with the Bid in a sealed opaque envelope. Address the envelope to the party receiving the Bids. Identify with the project name, project number, and the Bidder's name and address. If the Bid is sent by mail, enclose the sealed envelope in a separate mailing envelope with the notation "BID ENCLOSED" on the face thereof. The State is not responsible for the opening of bids prior to bid opening date and time that are not properly marked.

4.8.2 Deposit Bids at the designated location prior to the time and date for receipt of bids indicated in the Advertisement for Bids. Bids received after the time and date for receipt of bids will be marked "LATE BID" and returned.

4.8.3 Bidder assumes full responsibility for timely delivery at location designated for receipt of bids.

- 4.8.4 Oral, telephonic or telegraphic bids are invalid and will not receive consideration.
- 4.8.5 Withdrawn Bids may be resubmitted up to the date and time designated for the receipt of Bids, provided that they are then fully in compliance with these Instructions to Bidders.
- 4.9 **MODIFICATION OR WITHDRAW OF BIDS**
- 4.9.1 Prior to the closing date for receipt of Bids, a Bidder may withdraw a Bid by personal request and by showing proper identification to the Architect. A request for withdraw by letter or fax, if the Architect is notified in writing prior to receipt of fax, is acceptable. A fax directing a modification in the bid price will render the Bid informal, causing it to be ineligible for consideration of award. Telephone directives for modification of the bid price shall not be permitted and will have no bearing on the submitted proposal in any manner.
- 4.9.2 Bidders submitting Bids that are late shall be notified as soon as practicable and the bid shall be returned.
- 4.9.3 A Bid may not be modified, withdrawn or canceled by the Bidder during a thirty (30) day period following the time and date designated for the receipt and opening of Bids, and Bidder so agrees in submitting their Bid. Bids shall be binding for 30 days after the date of the Bid opening.

ARTICLE 5: CONSIDERATION OF BIDS

- 5.1 **OPENING/REJECTION OF BIDS**
- 5.1.1 Unless otherwise stated, Bids received on time will be publicly opened and will be read aloud. An abstract of the Bids will be made available to Bidders.
- 5.1.2 The Agency shall have the right to reject any and all Bids. A Bid not accompanied by a required Bid Security or by other data required by the Bidding Documents, or a Bid which is in any way incomplete or irregular is subject to rejection.
- 5.1.3 If the Bids are rejected, it will be done within thirty (30) calendar day of the Bid opening.
- 5.2 **COMPARISON OF BIDS**
- 5.2.1 After the Bids have been opened and read, the bid prices will be compared and the result of such comparisons will be made available to the public. Comparisons of the Bids may be based on the Base Bid plus desired Alternates. The Agency shall have the right to accept Alternates in any order or combination.
- 5.2.2 The Agency reserves the right to waive technicalities, to reject any or all Bids, or any portion thereof, to advertise for new Bids, to proceed to do the Work otherwise, or to abandon the Work, if in the judgment of the Agency or its agent(s), it is in the best interest of the State.
- 5.2.3 An increase or decrease in the quantity for any item is not sufficient grounds for an increase or decrease in the Unit Price.

- 5.2.4 The prices quoted are to be those for which the material will be furnished F.O.B. Job Site and include all charges that may be imposed during the period of the Contract.
- 5.2.5 No qualifying letter or statements in or attached to the Bid, or separate discounts will be considered in determining the low Bid except as may be otherwise herein noted. Cash or separate discounts should be computed and incorporated into Unit Bid Price(s).
- 5.3 DISQUALIFICATION OF BIDDERS
- 5.3.1 An agency shall determine that each Bidder on any Public Works Contract is responsible before awarding the Contract. Factors to be considered in determining the responsibility of a Bidder include:
- A. The Bidder's financial, physical, personnel or other resources including Subcontracts;
 - B. The Bidder's record of performance on past public or private construction projects, including, but not limited to, defaults and/or final adjudication or admission of violations of the Prevailing Wage Laws in Delaware or any other state;
 - C. The Bidder's written safety plan;
 - D. Whether the Bidder is qualified legally to contract with the State;
 - E. Whether the Bidder supplied all necessary information concerning its responsibility; and,
 - F. Any other specific criteria for a particular procurement, which an agency may establish; provided however, that, the criteria be set forth in the Invitation to Bid and is otherwise in conformity with State and/or Federal law.
- 5.3.2 If an agency determines that a Bidder is nonresponsive and/or nonresponsible, the determination shall be in writing and set forth the basis for the determination. A copy of the determination shall be sent to the affected Bidder within five (5) working days of said determination.
- 5.3.3 In addition, any one or more of the following causes may be considered as sufficient for the disqualification of a Bidder and the rejection of their Bid or Bids.
- 5.3.3.1 More than one Bid for the same Contract from an individual, firm or corporation under the same or different names.
 - 5.3.3.2 Evidence of collusion among Bidders.
 - 5.3.3.3 Unsatisfactory performance record as evidenced by past experience.

- 5.3.3.4 If the Unit Prices are obviously unbalanced either in excess or below reasonable cost analysis values.
- 5.3.3.5 If there are any unauthorized additions, interlineation, conditional or alternate bids or irregularities of any kind which may tend to make the Bid incomplete, indefinite or ambiguous as to its meaning.
- 5.3.3.6 If the Bid is not accompanied by the required Bid Security and other data required by the Bidding Documents.
- 5.3.3.7 If any exceptions or qualifications of the Bid are noted on the Bid Form.
- 5.4 ACCEPTANCE OF BID AND AWARD OF CONTRACT
 - 5.4.1 A formal Contract shall be executed with the successful Bidder within twenty (20) calendar days after the award of the Contract.
 - 5.4.2 Per Section 6962(d)(13)a., Title 29, Delaware Code, “The contracting agency shall award any public works contract within thirty (30) days of the bid opening to the lowest responsive and responsible Bidder, unless the Agency elects to award on the basis of best value, in which case the election to award on the basis of best value shall be stated in the Invitation To Bid. Any public school district and its board shall award public works contracts in accordance with this section’s requirements except it shall award the contract within 60 days of the bid opening.”
 - 5.4.3 Each Bid on any Public Works Contract must be deemed responsive by the Agency to be considered for award. A responsive Bid shall conform in all material respects to the requirements and criteria set forth in the Contract Documents and specifications.
 - 5.4.4 The Agency shall have the right to accept Alternates in any order or combination, and to determine the low Bidder on the basis of the sum of the Base Bid, plus accepted Alternates.
 - 5.4.5 The successful Bidder shall execute a formal contract, submit the required Insurance Certificate, and furnish good and sufficient bonds, unless specifically waived in the General Requirements, in accordance with the General Requirement, within twenty (20) days of official notice of contract award. The successful Bidder shall provide, at least two business days prior to contract execution, copies of the Employee Drug Testing Program for the Bidder and all listed Subcontractors. Bonds shall be for the benefit of the Agency with surety in the amount of 100% of the total contract award. Said Bonds shall be conditioned upon the faithful performance of the contract. Bonds shall remain in affect for period of two (2) years after the date of the Certificate of Final Payment.
 - 5.4.6 If the successful Bidder fails to execute the required Contract, Bond and all required information, as aforesaid, within twenty (20) calendar days after the date of official Notice of the Award of the Contract, their Bid guaranty shall immediately be taken and become the property of the State for the benefit of the Agency as liquidated damages, and not as a forfeiture or as a penalty. Award will then be made to the next lowest qualified Bidder of the Work or readvertised, as the Agency may decide.

- 5.4.7 Each bidder shall supply with its bid its taxpayer identification number (i.e., federal employer identification number or social security number) and should the vendor be awarded a contract, such vendor shall provide to the agency the taxpayer identification license numbers of such subcontractors. Such numbers shall be provided on the later of the date on which such subcontractor is required to be identified or the time the contract is executed. The successful Bidder shall provide to the agency to which it is contracting, within 30 days of entering into such public works contract, copies of all Delaware Business licenses of subcontractors and/or independent contractors that will perform work for such public works contract. However, if a subcontractor or independent contractor is hired or contracted more than 20 days after the Bidder entered the public works contract the Delaware Business license of such subcontractor or independent contractor shall be provided to the agency within 10 days of being contracted or hired.
- 5.4.8 The Bid Security shall be returned to the successful Bidder upon the execution of the formal contract. The Bid Securities of unsuccessful bidders shall be returned within thirty (30) calendar days after the opening of the Bids.

ARTICLE 6: POST-BID INFORMATION

- 6.1 CONTRACTOR'S QUALIFICATION STATEMENT
- 6.1.1 Bidders to whom an award of a Contract is under consideration shall, if requested by the Agency, submit a properly executed AIA Document A305, Contractor's Qualification Statement, unless such a statement has been previously required and submitted.
- 6.2 Bidders to whom an award of a Contract has been made must produce their Delaware Business License before the Contract can be executed.

ARTICLE 7: PERFORMANCE BOND AND PAYMENT BOND

- 7.1 BOND REQUIREMENTS
- 7.1.1 The cost of furnishing the required Bonds, that are stipulated in the Bidding Documents, shall be included in the Bid.
- 7.1.2 If the Bidder is required by the Agency to secure a bond from other than the Bidder's usual sources, changes in cost will be adjusted as provide in the Contract Documents.
- 7.1.3 The Performance and Payment Bond forms used shall be the standard OMB forms (attached).
- 7.2 TIME OF DELIVERY AND FORM OF BONDS
- 7.2.1 The bonds shall be dated on or after the date of the Contract.
- 7.2.2 The Bidder shall require the attorney-in-fact who executes the required bonds on behalf of the surety to affix a certified and current copy of the power of attorney.

ARTICLE 8: FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR

- 8.1 Unless otherwise required in the Bidding Documents, the Agreement for the Work will be written on AIA Document A101, Standard Form of Agreement Between Owner and Contractor Where the Basis of Payment is a Stipulated Sum.

END OF SECTION

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ADDITION TO BATTERY 519
CAPE HENLOPEN STATE PARK
15099 Cape Henlopen Drive
Lewes, DE 19958

DIVISION OF PARKS AND RECREATION CONTRACT No. NAT25814-FTMILESGC

BID FORM

For Bids Due: June 5, 2025 at 1:00 pm To: Dept. of Natural Resources and Environmental Control
Division of Parks and Recreation
Office of Design and Development
89 Kings Highway, Dover DE 19901

Name of Bidder: _____

Delaware Business License No.: _____ Taxpayer ID No.: _____

(Other License Nos.): _____

Phone No.: () _____ - _____ Fax No.: () _____ - _____

The undersigned, representing that he has read and understands the Bidding Documents and that this bid is made in accordance therewith, that he has visited the site and has familiarized himself with the local conditions under which the Work is to be performed, and that his bid is based upon the materials, systems and equipment described in the Bidding Documents without exception, hereby proposes and agrees to provide all labor, materials, plant, equipment, supplies, transport and other facilities required to execute the work described by the aforesaid documents for the lump sum itemized below:

\$ _____

(\$ _____)

Contingency Allowance Thirty Thousand Dollars and Zero Cents (\$30,000.00)

Total Bid

\$ _____

(\$ _____)

ADDITION TO BATTERY 519
CAPE HENLOPEN STATE PARK
15099 Cape Henlopen Drive
Lewes, DE 19958
DIVISION OF PARKS AND RECREATION CONTRACT No. NAT25814-FTMILESGC

BID FORM

UNIT PRICES

Unit prices conform to applicable project specification section. Refer to the specifications for a complete description of the following Unit Prices:

		DEDUCT	ADD
UNIT PRICE No. 1:	Repair of Exterior Concrete	\$ _____	\$ _____
UNIT PRICE No. 2:	Removal of Exterior Concrete	\$ _____	\$ _____

ADDITION TO BATTERY 519
CAPE HENLOPEN STATE PARK
15099 Cape Henlopen Drive
Lewes, DE 19958
DIVISION OF PARKS AND RECREATION CONTRACT No. NAT25814-FTMILESGC

BID FORM

I/We acknowledge Addendums numbered _____ and the price(s) submitted include any cost/schedule impact they may have.

This bid shall remain valid and cannot be withdrawn for thirty (30) days from the date of opening of bids (60 days for School Districts and Department of Education), and the undersigned shall abide by the Bid Security forfeiture provisions. Bid Security is attached to this Bid.

The Owner shall have the right to reject any or all bids, and to waive any informality or irregularity in any bid received.

This bid is based upon work being accomplished by the Sub-Contractors named on the list attached to this bid.

Should I/We be awarded this contract, I/We pledge to achieve substantial completion of all the work within _____ calendar days of the Notice to Proceed.

The undersigned represents and warrants that he has complied and shall comply with all requirements of local, state, and national laws; that no legal requirement has been or shall be violated in making or accepting this bid, in awarding the contract to him or in the prosecution of the work required; that the bid is legal and firm; that he has not, directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken action in restraint of free competitive bidding.

Upon receipt of written notice of the acceptance of this Bid, the Bidder shall, within twenty (20) calendar days, execute the agreement in the required form and deliver the Contract Bonds, and Insurance Certificates, required by the Contract Documents.

I am / We are an Individual / a Partnership / a Corporation

By _____ Trading as _____
(Individual's / General Partner's / Corporate Name)

(State of Corporation)

Business Address: _____

ADDITION TO BATTERY 519
CAPE HENLOPEN STATE PARK
15099 Cape Henlopen Drive
Lewes, DE 19958
DIVISION OF PARKS AND RECREATION CONTRACT No. NAT25814-FTMILESGC

BID FORM

Witness: _____ **By:** _____
(*Authorized Signature*)

(*SEAL*) _____
(*Title*)
Date: _____

ATTACHMENTS

Sub-Contractor List
Non-Collusion Statement
Affidavit of Employee Drug Testing Program
Affidavit of Contractor Qualifications
Bid Security
(Others as Required by Project Manuals)

ADDITION TO BATTERY 519
CAPE HENLOPEN STATE PARK
15099 Cape Henlopen Drive
Lewes, DE 19958
DIVISION OF PARKS AND RECREATION CONTRACT No. NAT25814-FTMILESGC

BID FORM

SUBCONTRACTOR LIST

In accordance with Title 29, Chapter 69, Section 6962(d)(10)b of the Delaware Code, the following subcontractor listing must accompany any bid submittal. The bidder must list **in each category** the full name and address (City & State) of the sub-contractor that the bidder will be using to perform the work and provide material for that subcontractor category. Should the bidder's listed subcontractor intend to provide any of their subcontractor category of work through a third-tier contractor, the bidder shall list that third-tier contractor's full name and address (City & State). **If the bidder intends to perform any category of work itself, it must list its full name and address.** For clarification, if the bidder intends to perform the work themselves, the bidder **may not** insert "not applicable", "N/A", "self" or anything other than its own full name and address (City & State). To do so shall cause the bid to be rejected. In addition, the failure to produce a completed subcontractor list with the bid submittal shall cause the bid to be rejected. If you have more than three (3) third-tier contractors to report in any subcontractor category, print out additional page(s) containing the appropriate category, complete the rest of your list of third-tier contractors for that category, notate the addition in parentheses as (CONTINUATION) next to the subcontractor category and an asterisk (*) next to any additional third-tier contractors, and submit it with your bid.

Subcontractor Category	Subcontractor	Address (City & State)	Subcontractors tax payer ID # or Delaware Business license #
1. Sitework-A			
Sitework-B			
Sitework-C			
2. Paving -A			
Paving -B			
Paving -C			
3. Hardscape-A			
Hardscape-B			
Hardscape-C			
4. Landscape-A			

	Landscape-B		
	Landscape-C		
5.	Masonry-A		
	Masonry-B		
	Masonry-C		
6.	Steel-A		
	Steel-B		
	Steel-C		
7.	Cold-Formed Metal Framing-A		
	Cold-Formed Metal Framing-B		
	Cold-Formed Metal Framing-C		
8.	Doors, Frames & Hardware-A		
	Doors, Frames & Hardware-B		
	Doors, Frames & Hardware-C		
9.	Painting-A		
	Painting-B		
	Painting-C		
10.	Concrete-A		
	Concrete-B		
	Concrete-C		
11.	Roofing-A		
	Roofing-B		

	Roofing-C			
12.	Mechanical-A			
	Mechanical-B			
	Mechanical-C			
13.	Plumbing-A			
	Plumbing-B			
	Plumbing-C			
14.	Electric-A			
	Electric-B			
	Electric-C			
15.	Site Utilities-A			
	Site Utilities-B			
	Site Utilities-C			
16.	Electric-A			
	Electric-B			
	Electric-C			
17.	Fencing-A			
	Fencing-B			
	Fencing-C			

ADDITION TO BATTERY 519
CAPE HENLOPEN STATE PARK
15099 Cape Henlopen Drive
Lewes, DE 19958
DIVISION OF PARKS AND RECREATION CONTRACT No. NAT25814-FTMILESGC

BID FORM
NON-COLLUSION STATEMENT

This is to certify that the undersigned bidder has neither directly nor indirectly, entered into any agreement, participated in any collusion or otherwise taken any action in restraint of free competitive bidding in connection with this proposal submitted this date to the Division of Natural Resources and Environmental Control.

All the terms and conditions of the *Addition to Battery 519* have been thoroughly examined and are understood.

NAME OF BIDDER: _____

**AUTHORIZED REPRESENTATIVE
(TYPED):** _____

**AUTHORIZED REPRESENTATIVE
(SIGNATURE):** _____

TITLE: _____

ADDRESS OF BIDDER: _____

E-MAIL: _____

PHONE NUMBER: _____

Sworn to and Subscribed before me this _____ day of _____ 20____.

My Commission expires _____. NOTARY PUBLIC _____.

THIS PAGE MUST BE SIGNED AND NOTARIZED FOR YOUR BID TO BE CONSIDERED.

ADDITION TO BATTERY 519
CAPE HENLOPEN STATE PARK
15099 Cape Henlopen Drive
Lewes, DE 19958
DIVISION OF PARKS AND RECREATION CONTRACT No. NAT25814-FTMILESGC

**AFFIDAVIT
OF
EMPLOYEE DRUG TESTING PROGRAM**

4104 Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on Large Public Works Projects requires that Contractors and Subcontractors implement a program of mandatory drug testing for Employees who work on Large Public Works Contracts funded all or in part with public funds.

We hereby certify that we have in place or will implement during the entire term of the contract a Mandatory Drug Testing Program for our employees on the jobsite, including subcontractors, that complies with this regulation:

Contractor/Subcontractor Name: _____

Contractor/Subcontractor Address: _____

Authorized Representative (typed or printed): _____

Authorized Representative (signature): _____

Title: _____

Sworn to and Subscribed before me this _____ day of _____ 20____.

My Commission expires _____. NOTARY PUBLIC _____.

THIS PAGE MUST BE SIGNED AND NOTARIZED FOR YOUR BID TO BE CONSIDERED.

ADDITION TO BATTERY 519
CAPE HENLOPEN STATE PARK
15099 Cape Henlopen Drive
Lewes, DE 19958
DIVISION OF PARKS AND RECREATION CONTRACT No. NAT25814-FTMILESGC

**AFFIDAVIT
OF
CONTRACTOR QUALIFICATIONS**

We hereby certify that we will abide by the contractor's qualifications outlined in the construction bid specifications for the duration of the contract term.

In accordance with Title 29, Chapter 69, Section 6962(d)(10)b.3 of the Delaware Code, after a contract has been awarded the successful bidder shall not substitute another subcontractor whose name was submitted on the Subcontractor Form except for the reasons in the statute and not without written consent from the awarding agency. Failure to utilize the subcontractors on the list will subject the successful bidder to penalties as outlined in the General Requirements Section 5.2 of the contract.

Contractor Name: _____

Contractor Address: _____

Authorized Representative (typed or printed): _____

Authorized Representative (signature): _____

Title: _____

Sworn to and Subscribed before me this _____ day of _____ 20____.

My Commission expires _____. NOTARY PUBLIC _____.

THIS PAGE MUST BE SIGNED AND NOTARIZED FOR YOUR BID TO BE CONSIDERED

BID BOND

TO ACCOMPANY PROPOSAL
(Not necessary if security is used)

KNOW ALL MEN BY THESE PRESENTS That: _____
_____ of _____ in the County of _____
_____ and State of _____ as **Principal**, and _____
_____ of _____ in the County of _____
and State of _____ as **Surety**, legally authorized to do business in the State of Delaware
("State"), are held and firmly unto the **State** in the sum of _____
_____ Dollars (\$_____), or _____ percent not to exceed _____
_____ Dollars (\$_____)
of amount of bid on Contract No. NAT25814-FTMILESGC, to be paid to the **State** for the use and benefit of
Department of Natural Resources and Environmental Control for which payment well and truly to
be made, we do bind ourselves, our and each of our heirs, executors, administrators, and successors, jointly
and severally for and in the whole firmly by these presents.

NOW THE CONDITION OF THIS OBLIGATION IS SUCH That if the above bonded **Principal**
who has submitted to the **Department of Natural Resources and Environmental Control** a certain
proposal to enter into this contract for the furnishing of certain material and/or services within the **State**,
shall be awarded this Contract, and if said **Principal** shall well and truly enter into and execute this Contract
as may be required by the terms of this Contract and approved by the **Department of Natural Resources
and Environmental Control** this Contract to be entered into within twenty days after the date of official
notice of the award thereof in accordance with the terms of said proposal, then this obligation shall be void or
else to be and remain in full force and virtue.

Sealed with _____ seal and dated this _____ day of _____ in the year of our Lord two
thousand and _____ (20____).

SEALED, AND DELIVERED IN THE
Presence of

Name of Bidder (Organization)

Corporate
Seal

By:

Authorized Signature

Attest _____

Title

Name of Surety

Witness: _____

By:

Title

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SECTION 00 52 13

STANDARD FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR AIA 101-2017

The contract to be utilized on this project shall be the “Standard Form of Agreement Between Owner and Contractor” AIA Document A101-2017, including AIA Document A101 – 2017 Exhibit A, as well as Supplements to A101-2017 and Exhibit A and the State of Delaware’s General Requirements.

(THIS PAGE INTENTIONALLY LEFT BLANK)

AIA[®] Document A101[™] – 2017

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

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

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

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

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

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

The Owner and Contractor agree as follows.

ADDITIONS AND DELETIONS:

The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed. 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.

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

TABLE OF ARTICLES

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

EXHIBIT A INSURANCE AND BONDS

ARTICLE 1 THE CONTRACT DOCUMENTS

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

ARTICLE 2 THE WORK OF THIS CONTRACT

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

ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

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

(Check one of the following boxes.)

- ☐ The date of this Agreement.
- ☐ A date set forth in a notice to proceed issued by the Owner.
- ☐ Established as follows:

(Insert a date or a means to determine the date of commencement of the Work.)

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

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

§ 3.3 Substantial Completion

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

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

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

☐ By the following date:

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

Portion of Work

Substantial Completion Date

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

ARTICLE 4 CONTRACT SUM

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

§ 4.2 Alternates

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

Item

Price

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

Item

Price

Conditions for Acceptance

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

Item

Price

§ 4.4 Unit prices, if any:

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

Item

Units and Limitations

Price per Unit (\$0.00)

§ 4.5 Liquidated damages, if any:

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

§ 4.6 Other:

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

Init.

ARTICLE 5 PAYMENTS

§ 5.1 Progress Payments

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

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

§ 5.1.3 Provided that an Application for Payment is received by the Architect not later than the day of a month, the Owner shall make payment of the amount certified to the Contractor not later than the day of the month. If an Application for Payment is received by the Architect after the application date fixed above, payment of the amount certified shall be made by the Owner not later than () days after the Architect receives the Application for Payment.

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

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

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

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

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

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

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

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

§ 5.1.7 Retainage

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

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

§ 5.1.7.1.1 The following items are not subject to retainage:

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

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

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

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

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

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

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

§ 5.2 Final Payment

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

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

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

§ 5.3 Interest

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

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

%

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 Initial Decision Maker

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

§ 6.2 Binding Dispute Resolution

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

(Check the appropriate box.)

☐ Arbitration pursuant to Section 15.4 of AIA Document A201–2017

☐ Litigation in a court of competent jurisdiction

☐ Other *(Specify)*

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

ARTICLE 7 TERMINATION OR SUSPENSION

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

§ 7.1.1 If the Contract is terminated for the Owner's convenience in accordance with Article 14 of AIA Document A201–2017, then the Owner shall pay the Contractor a termination fee as follows:

(Insert the amount of, or method for determining, the fee, if any, payable to the Contractor following a termination for the Owner's convenience.)

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

ARTICLE 8 MISCELLANEOUS PROVISIONS

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

§ 8.2 The Owner's representative:

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

§ 8.3 The Contractor's representative:

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

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

§ 8.5 Insurance and Bonds

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

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

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

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

§ 8.7 Other provisions:

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 This Agreement is comprised of the following documents:

- .1 AIA Document A101™-2017, Standard Form of Agreement Between Owner and Contractor
- .2 AIA Document A101™-2017, Exhibit A, Insurance and Bonds
- .3 AIA Document A201™-2017, General Conditions of the Contract for Construction
- .4 AIA Document E203™-2013, Building Information Modeling and Digital Data Exhibit, dated as indicated below:
(Insert the date of the E203-2013 incorporated into this Agreement.)

.5 Drawings

Number	Title	Date

.6 Specifications

Section	Title	Date	Pages

.7 Addenda, if any:

Number	Date	Pages

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

.8 Other Exhibits:

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

Init.

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

☐ The Sustainability Plan:

Title	Date	Pages

☐ Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages

.9 Other documents, if any, listed below:

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

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

OWNER (Signature)

CONTRACTOR (Signature)

(Printed name and title)

(Printed name and title)

Init.



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 day of in the year
(In words, indicate day, month and year.)

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

THE OWNER:
(Name, legal status and address)

THE CONTRACTOR:
(Name, legal status and address)

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 A201™–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, 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.)

Init.

[] § 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.)

Init.

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:

Init.

SECTION 00 54 13

AIA 201-2017 SUPPLEMENT TO AGREEMENT BETWEEN OWNER AND CONTRACTOR A101-2017

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SECTION 00 54 13

SUPPLEMENT TO AGREEMENT BETWEEN OWNER AND CONTRACTOR A101-2017

The following supplements modify the “Standard Form of Agreement Between Owner and Contractor,” AIA Document A101-2017. Where a portion of the Standard Form of Agreement is modified or deleted by the following, the unaltered portions of the Standard Form of Agreement shall remain in effect.

ARTICLE 3: DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

3.1 Delete paragraph 3.1 in its entirety and replace with the following:

“The date of Commencement of the Work shall be a date set forth in a notice to proceed issued by the Owner.”

ARTICLE 5: PAYMENTS

5.1 PROGRESS PAYMENTS

5.1.3 Delete paragraph 5.1.3 in its entirety and replace with the following:

“Provided that a valid Application for Payment is received by the Architect that meets all requirements of the Contract, payment shall be made by the Owner not later than 30 days after the Owner receives the valid Application for Payment.”

5.3 Insert the interest rate of “1% per month not to exceed 12% per annum.”

ARTICLE 6: DISPUTE RESOLUTION

6.2 BINDING DISPUTE RESOLUTION

Check Other – and add the following sentence:

"Any remedies available in law or in equity."

ARTICLE 7: TERMINATION or SUSPENSION

7.1.1 Delete paragraph 7.1.1 in its entirety.

ARTICLE 8: MISCELLANEOUS PROVISIONS

8.4 Delete paragraph 8.4 in its entirety and replace with the following:

“The Contractor’s representative shall not be changed without ten days written notice to the Owner.”

END OF SUPPLEMENT TO AGREEMENT BETWEEN OWNER AND CONTRACTOR

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SECTION 00 54 14
SUPPLEMENT TO A101-2017 – EXHIBIT ‘A’ INSURANCE AND BONDS

The following supplements modify the “Standard Form of Agreement Between Owner and Contractor,” AIA Document A101-2017 Exhibit A Insurance and Bonds. Where a portion of the Standard Form of Agreement is modified or deleted by the following, the unaltered portions of the Standard Form of Agreement shall remain in effect.

ARTICLE A.2 OWNER’S INSURANCE

A.2.1 General

Delete paragraph A.2.1 in its entirety.

A.2.2 Liability Insurance

Delete paragraph A.2.2 in its entirety, except in the case of school projects this paragraph shall remain.

A.2.3 Required Property Insurance

Delete paragraph A.2.3 in its entirety.

A.2.4 Optional Extended Property Insurance

Delete paragraph A.2.4 in its entirety.

A.2.5 Other Optional Insurance

Delete paragraph A.2.5 in its entirety.

ARTICLE A.3 CONTRACTORS INSURANCE AND BONDS

A.3.1.1 Strike the last sentence of the paragraph.

A.3.1.3 Additional Insured Obligations

In the first sentence after “coverage to include (1)” delete “(1) the Owner,”.

Strike the remainder of the first sentence beginning at the semicolon “; and (2) the Owner” through the end of the sentence.

Delete the second sentence in its entirety.

- A.3.2.2.1** Insert “\$1,000,000.00” in the blank for each occurrence.
Insert “\$3,000,000.00” in the blank for general aggregate.
Insert “\$3,000,000.00” in the blank for aggregate for products-completed operations hazard.

A.3.2.3 Insert “\$1,000,000.00” in the blank for per accident.

- A.3.2.6 Insert "\$500,000.00" in the blank for each accident.
Insert "\$500,000.00" in the blank for each employee.
Insert "\$500,000.00" in the blank for policy limit.
- A.3.2.8 Insert "\$1,000,000.00" in the blank for per claim.
Insert "\$3,000,000.00" in the blank for in the aggregate.
- A.3.2.9 Insert "\$1,000,000.00" in the blank for per claim.
Insert "\$3,000,000.00" in the blank for in the aggregate.
- A.3.2.10 Insert "\$2,000,000.00" in the blank for per claim.
Insert "\$4,000,000.00" in the blank for in the aggregate.
- A.3.2.11 Strike in its entirety.
- A.3.2.12 Strike in its entirety.
- A.3.3.2.1 Delete paragraph 3.3.2.1 in its entirety
- A.3.3.2.2 Strike in its entirety.
- A.3.3.2.3 Insert "\$1,000,000.00" in the blanks for per claim.
Insert "\$3,000,000.00" in the blanks for in the aggregate.
- A.3.4 Insert the actual contract price in both the Payment Bond and the Performance Bond Penal Sum blanks. It must be 100% of the contract price.

Strike the last sentence in this section and replace with "Payment and Performance Bonds shall be in the standard form issued by the Delaware Office of Management and Budget."

END OF SECTION

STATE OF DELAWARE
OFFICE OF MANAGEMENT AND BUDGET

PERFORMANCE BOND

Bond Number: _____

KNOW ALL PERSONS BY THESE PRESENTS, that we, _____, as principal (“**Principal**”), and _____, a _____ corporation, legally authorized to do business in the State of Delaware, as surety (“**Surety**”), are held and firmly bound unto the **Department of Natural Resources and Environmental Control** (“**Owner**”), in the amount of _____ (\$ _____), to be paid to **Owner**, for which payment well and truly to be made, we do bind ourselves, our and each and every of our heirs, executors, administrations, successors and assigns, jointly and severally, for and in the whole, firmly by these presents.

Sealed with our seals and dated this _____ day of _____, 20__.

NOW THE CONDITION OF THIS OBLIGATION IS SUCH, that if **Principal**, who has been awarded by **Owner** that certain contract known as Contract No. _____ dated the _____ day of _____, 20__ (the “Contract”), which Contract is incorporated herein by reference, shall well and truly provide and furnish all materials, appliances and tools and perform all the work required under and pursuant to the terms and conditions of the Contract and the Contract Documents (as defined in the Contract) or any changes or modifications thereto made as therein provided, shall make good and reimburse **Owner** sufficient funds to pay the costs of completing the Contract that **Owner** may sustain by reason of any failure or default on the part of **Principal**, and shall also indemnify and save harmless **Owner** from all costs, damages and expenses arising out of or by reason of the performance of the Contract and for as long as provided by the Contract; then this obligation shall be void, otherwise to be and remain in full force and effect.

Surety, for value received, hereby stipulates and agrees, if requested to do so by **Owner**, to fully perform and complete the work to be performed under the Contract pursuant to the terms, conditions and covenants thereof, if for any cause **Principal** fails or neglects to so fully perform and complete such work.

Surety, for value received, for itself and its successors and assigns, hereby stipulates and agrees that the obligation of **Surety** and its bond shall be in no way impaired or affected by any extension of time, modification, omission, addition or change in or to the Contract or the work to be performed thereunder, or by any payment thereunder before the time required therein, or by any waiver of any provisions thereof, or by any assignment, subletting or other transfer thereof or of any work to be performed or any monies due or to become due thereunder; and **Surety** hereby waives notice of any and all such extensions, modifications, omissions, additions, changes, payments, waivers, assignments, subcontracts and transfers and hereby expressly stipulates and agrees that any and all

things done and omitted to be done by and in relation to assignees, subcontractors, and other transferees shall have the same effect as to **Surety** as though done or omitted to be done by or in relation to **Principal**.

Surety hereby stipulates and agrees that no modifications, omissions or additions in or to the terms of the Contract shall in any way whatsoever affect the obligation of **Surety** and its bond.

Any proceeding, legal or equitable, under this Bond may be brought in any court of competent jurisdiction in the State of Delaware. Notices to **Surety** or Contractor may be mailed or delivered to them at their respective addresses shown below.

IN WITNESS WHEREOF, **Principal** and **Surety** have hereunto set their hand and seals, and such of them as are corporations have caused their corporate seal to be hereto affixed and these presents to be signed by their duly authorized officers, the day and year first above written.

PRINCIPAL

Name: _____

Witness or Attest: Address: _____

Name:

(Corporate Seal)

By: _____ (SEAL)
Name:
Title:

SURETY

Name: _____

Witness or Attest: Address: _____

Name:

(Corporate Seal)

By: _____ (SEAL)
Name:
Title:

STATE OF DELAWARE
OFFICE OF MANAGEMENT AND BUDGET

PAYMENT BOND

Bond Number: _____

KNOW ALL PERSONS BY THESE PRESENTS, that we, _____, as principal (“**Principal**”), and _____, a _____ corporation, legally authorized to do business in the State of Delaware, as surety (“**Surety**”), are held and firmly bound unto the **Department Natural Resources and of Environmental Control** (“**Owner**”), in the amount of _____ (\$_____), to be paid to **Owner**, for which payment well and truly to be made, we do bind ourselves, our and each and every of our heirs, executors, administrations, successors and assigns, jointly and severally, for and in the whole firmly by these presents.

Sealed with our seals and dated this _____ day of _____, 20__.

NOW THE CONDITION OF THIS OBLIGATION IS SUCH, that if **Principal**, who has been awarded by **Owner** that certain contract known as Contract No. _____ dated the _____ day of _____, 20__ (the “Contract”), which Contract is incorporated herein by reference, shall well and truly pay all and every person furnishing materials or performing labor or service in and about the performance of the work under the Contract, all and every sums of money due him, her, them or any of them, for all such materials, labor and service for which **Principal** is liable, shall make good and reimburse **Owner** sufficient funds to pay such costs in the completion of the Contract as **Owner** may sustain by reason of any failure or default on the part of **Principal**, and shall also indemnify and save harmless **Owner** from all costs, damages and expenses arising out of or by reason of the performance of the Contract and for as long as provided by the Contract; then this obligation shall be void, otherwise to be and remain in full force and effect.

Surety, for value received, for itself and its successors and assigns, hereby stipulates and agrees that the obligation of **Surety** and its bond shall be in no way impaired or affected by any extension of time, modification, omission, addition or change in or to the Contract or the work to be performed thereunder, or by any payment thereunder before the time required therein, or by any waiver of any provisions thereof, or by any assignment, subletting or other transfer thereof or of any work to be performed or any monies due or to become due thereunder; and **Surety** hereby waives notice of any and all such extensions, modifications, omissions, additions, changes, payments, waivers, assignments, subcontracts and transfers and hereby expressly stipulates and agrees that any and all things done and omitted to be done by and in relation to assignees, subcontractors, and other transferees shall have the same effect as to **Surety** as though done or omitted to be done by or in relation to **Principal**.

Surety hereby stipulates and agrees that no modifications, omission or additions in or to the terms of the Contract shall in any way whatsoever affect the obligation of **Surety** and its bond.

Any proceeding, legal or equitable, under this Bond may be brought in any court of competent jurisdiction in the State of Delaware. Notices to **Surety** or Contractor may be mailed or delivered to them at their respective addresses shown below.

IN WITNESS WHEREOF, **Principal** and **Surety** have hereunto set their hand and seals, and such of them as are corporations have caused their corporate seal to be hereto affixed and these presents to be signed by their duly authorized officers, the day and year first above written.

PRINCIPAL

Name: _____

Witness or Attest: Address: _____

Name:

(Corporate Seal)

By: _____(SEAL)
Name:
Title:

SURETY

Name: _____

Witness or Attest: Address: _____

Name:

(Corporate Seal)

By: _____(SEAL)
Name:
Title:

SECTION 00 62 76

APPLICATION & CERTIFICATION OF PAYMENT AIA G-702 WITH CONTINUATION SHEET G-703

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Application and Certificate for Payment

TO OWNER:	PROJECT: BHH	APPLICATION NO: 001	Distribution to:
		PERIOD TO:	☐ OWNER: ☐
FROM	VIA	CONTRACT FOR: General Construction	☐ ARCHITECT: ☐
CONTRACTOR:	ARCHITECT:	CONTRACT DATE:	☐ CONTRACTOR: ☐
		PROJECT NOS: / /	☐ FIELD: ☐
			☐ OTHER: ☐

Bernardon Haber Holloway Architects
PC
Three Mill Road, Suite 211
Wilmington, Delaware 19806

CONTRACTOR'S APPLICATION FOR PAYMENT

Application is made for payment, as shown below, in connection with the Contract Continuation Sheet, AIA Document G703, is attached.

1. ORIGINAL CONTRACT SUM \$ 0.00
2. Net change by Change Orders \$ 0.00
3. CONTRACT SUM TO DATE (Line 1 ± 2) \$ 0.00
4. TOTAL COMPLETED & STORED TO DATE (Column G on G703) \$ 0.00

5. RETAINAGE:

- a. 0 % of Completed Work
(Column D + E on G703) \$ 0.00
- b. 0 % of Stored Material
(Column F on G703) \$ 0.00

Total Retainage (Lines 5a + 5b or Total in Column I of G703) \$ 0.00

6. TOTAL EARNED LESS RETAINAGE \$ 0.00

(Line 4 Less Line 5 Total)

7. LESS PREVIOUS CERTIFICATES FOR PAYMENT \$ 0.00

(Line 6 from prior Certificate)

8. CURRENT PAYMENT DUE \$ 0.00

9. BALANCE TO FINISH, INCLUDING RETAINAGE

(Line 3 less Line 6)

CHANGE ORDER SUMMARY	ADDITIONS	DEDUCTIONS
Total changes approved in previous months by Owner	\$ 0.00	\$ 0.00
Total approved this Month	\$ 0.00	\$ 0.00
TOTALS	\$ 0.00	\$ 0.00
NET CHANGES by Change Order		\$ 0.00

The undersigned Contractor certifies that to the best of the Contractor's knowledge, information and belief the Work covered by this Application for Payment has been completed in accordance with the Contract Documents, that all amounts have been paid by the Contractor for Work for which previous Certificates for Payment were issued and payments received from the Owner, and that current payment shown herein is now due.

CONTRACTOR:

By: _____ Date: _____

State of: _____

County of: _____

Subscribed and sworn to before
me this _____ day of _____

Notary Public:

My Commission expires: _____

ARCHITECT'S CERTIFICATE FOR PAYMENT

In accordance with the Contract Documents, based on on-site observations and the data comprising this application, the Architect certifies to the Owner that to the best of the Architect's knowledge, information and belief the Work has progressed as indicated, the quality of the Work is in accordance with the Contract Documents, and the Contractor is entitled to payment of the AMOUNT CERTIFIED.

AMOUNT CERTIFIED \$ 0.00

(Attach explanation if amount certified differs from the amount applied. Initial all figures on this Application and on the Continuation Sheet that are changed to conform with the amount certified.)

ARCHITECT:

By: _____ Date: _____

This Certificate is not negotiable. The AMOUNT CERTIFIED is payable only to the Contractor named herein. Issuance, payment and acceptance of payment are without prejudice to any rights of the Owner or Contractor under this Contract

AIA[®] Document G703[™] – 1992

Continuation Sheet

AIA Document G702, APPLICATION AND CERTIFICATION FOR PAYMENT, containing Contractor's signed certification is attached.

In tabulations below, amounts are stated to the nearest dollar.

Use Column I on Contracts where variable retainage for line items may apply.

APPLICATION NO: 001

APPLICATION DATE:

PERIOD TO:

ARCHITECT'S PROJECT NO:

A ITEM NO.	B DESCRIPTION OF WORK	C SCHEDULED VALUE	D WORK COMPLETED		E THIS PERIOD	F MATERIALS PRESENTLY STORED (NOT IN D OR E)	G TOTAL COMPLETED AND STORED TO DATE (D+E+F)	H BALANCE TO FINISH (C - G)	I RETAINAGE (IF VARIABLE RATE)
			FROM PREVIOUS APPLICATION (D + E)	THIS PERIOD					
		\$ 0.00	\$ 0.00		\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00
	GRAND TOTAL								

SECTION 00 72 13

**GENERAL CONDITIONS TO THE CONTRACT
A201-2017**

The General Conditions of this Contract are as stated in the American Institute of Architects Document AIA A201 (2017 Edition) entitled General Conditions of the Contract for Construction as revised by the Supplementary General Conditions and is part of this project manual as if herein written in full.

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AIA® Document A201™ – 2017

General Conditions of the Contract for Construction

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

THE OWNER:
(Name, legal status and address)

THE ARCHITECT:
(Name, legal status and address)

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.

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

Init.

INDEX

(Topics and numbers in bold are Section headings.)

Acceptance of Nonconforming Work
9.6.6, 9.9.3, 12.3
Acceptance of Work
9.6.6, 9.8.2, 9.9.3, 9.10.1, 9.10.3, 12.3
Access to Work
3.16, 6.2.1, 12.1
Accident Prevention
10
Acts and Omissions
3.2, 3.3.2, 3.12.8, 3.18, 4.2.3, 8.3.1, 9.5.1, 10.2.5,
10.2.8, 13.3.2, 14.1, 15.1.2, 15.2
Addenda
1.1.1
Additional Costs, Claims for
3.7.4, 3.7.5, 10.3.2, 15.1.5
Additional Inspections and Testing
9.4.2, 9.8.3, 12.2.1, 13.4
Additional Time, Claims for
3.2.4, 3.7.4, 3.7.5, 3.10.2, 8.3.2, 15.1.6
Administration of the Contract
3.1.3, 4.2, 9.4, 9.5
Advertisement or Invitation to Bid
1.1.1
Aesthetic Effect
4.2.13
Allowances
3.8
Applications for Payment
4.2.5, 7.3.9, 9.2, 9.3, 9.4, 9.5.1, 9.5.4, 9.6.3, 9.7, 9.10
Approvals
2.1.1, 2.3.1, 2.5, 3.1.3, 3.10.2, 3.12.8, 3.12.9,
3.12.10.1, 4.2.7, 9.3.2, 13.4.1
Arbitration
8.3.1, 15.3.2, 15.4
ARCHITECT
4
Architect, Definition of
4.1.1
Architect, Extent of Authority
2.5, 3.12.7, 4.1.2, 4.2, 5.2, 6.3, 7.1.2, 7.3.4, 7.4, 9.2,
9.3.1, 9.4, 9.5, 9.6.3, 9.8, 9.10.1, 9.10.3, 12.1, 12.2.1,
13.4.1, 13.4.2, 14.2.2, 14.2.4, 15.1.4, 15.2.1
Architect, Limitations of Authority and
Responsibility
2.1.1, 3.12.4, 3.12.8, 3.12.10, 4.1.2, 4.2.1, 4.2.2,
4.2.3, 4.2.6, 4.2.7, 4.2.10, 4.2.12, 4.2.13, 5.2.1, 7.4,
9.4.2, 9.5.4, 9.6.4, 15.1.4, 15.2
Architect's Additional Services and Expenses
2.5, 12.2.1, 13.4.2, 13.4.3, 14.2.4
Architect's Administration of the Contract
3.1.3, 3.7.4, 15.2, 9.4.1, 9.5
Architect's Approvals

2.5, 3.1.3, 3.5, 3.10.2, 4.2.7
Architect's Authority to Reject Work
3.5, 4.2.6, 12.1.2, 12.2.1
Architect's Copyright
1.1.7, 1.5
Architect's Decisions
3.7.4, 4.2.6, 4.2.7, 4.2.11, 4.2.12, 4.2.13, 4.2.14, 6.3,
7.3.4, 7.3.9, 8.1.3, 8.3.1, 9.2, 9.4.1, 9.5, 9.8.4, 9.9.1,
13.4.2, 15.2
Architect's Inspections
3.7.4, 4.2.2, 4.2.9, 9.4.2, 9.8.3, 9.9.2, 9.10.1, 13.4
Architect's Instructions
3.2.4, 3.3.1, 4.2.6, 4.2.7, 13.4.2
Architect's Interpretations
4.2.11, 4.2.12
Architect's Project Representative
4.2.10
Architect's Relationship with Contractor
1.1.2, 1.5, 2.3.3, 3.1.3, 3.2.2, 3.2.3, 3.2.4, 3.3.1, 3.4.2,
3.5, 3.7.4, 3.7.5, 3.9.2, 3.9.3, 3.10, 3.11, 3.12, 3.16,
3.18, 4.1.2, 4.2, 5.2, 6.2.2, 7, 8.3.1, 9.2, 9.3, 9.4, 9.5,
9.7, 9.8, 9.9, 10.2.6, 10.3, 11.3, 12, 13.3.2, 13.4, 15.2
Architect's Relationship with Subcontractors
1.1.2, 4.2.3, 4.2.4, 4.2.6, 9.6.3, 9.6.4, 11.3
Architect's Representations
9.4.2, 9.5.1, 9.10.1
Architect's Site Visits
3.7.4, 4.2.2, 4.2.9, 9.4.2, 9.5.1, 9.9.2, 9.10.1, 13.4
Asbestos
10.3.1
Attorneys' Fees
3.18.1, 9.6.8, 9.10.2, 10.3.3
Award of Separate Contracts
6.1.1, 6.1.2
Award of Subcontracts and Other Contracts for
Portions of the Work
5.2
Basic Definitions
1.1
Bidding Requirements
1.1.1
Binding Dispute Resolution
8.3.1, 9.7, 11.5, 13.1, 15.1.2, 15.1.3, 15.2.1, 15.2.5,
15.2.6.1, 15.3.1, 15.3.2, 15.3.3, 15.4.1
Bonds, Lien
7.3.4.4, 9.6.8, 9.10.2, 9.10.3
Bonds, Performance, and Payment
7.3.4.4, 9.6.7, 9.10.3, 11.1.2, 11.1.3, 11.5
Building Information Models Use and Reliance
1.8
Building Permit
3.7.1
Capitalization
1.3
Certificate of Substantial Completion
9.8.3, 9.8.4, 9.8.5

Certificates for Payment
 4.2.1, 4.2.5, 4.2.9, 9.3.3, 9.4, 9.5, 9.6.1, 9.6.6, 9.7,
 9.10.1, 9.10.3, 14.1.1.3, 14.2.4, 15.1.4
 Certificates of Inspection, Testing or Approval
 13.4.4
 Certificates of Insurance
 9.10.2
 Change Orders
 1.1.1, 3.4.2, 3.7.4, 3.8.2.3, 3.11, 3.12.8, 4.2.8, 5.2.3,
 7.1.2, 7.1.3, 7.2, 7.3.2, 7.3.7, 7.3.9, 7.3.10, 8.3.1,
 9.3.1.1, 9.10.3, 10.3.2, 11.2, 11.5, 12.1.2
 Change Orders, Definition of
 7.2.1
 CHANGES IN THE WORK
 2.2.2, 3.11, 4.2.8, 7, 7.2.1, 7.3.1, 7.4, 8.3.1, 9.3.1.1,
 11.5
 Claims, Definition of
 15.1.1
 Claims, Notice of
 1.6.2, 15.1.3
 CLAIMS AND DISPUTES
 3.2.4, 6.1.1, 6.3, 7.3.9, 9.3.3, 9.10.4, 10.3.3, 15, 15.4
 Claims and Timely Assertion of Claims
 15.4.1
 Claims for Additional Cost
 3.2.4, 3.3.1, 3.7.4, 7.3.9, 9.5.2, 10.2.5, 10.3.2, 15.1.5
 Claims for Additional Time
 3.2.4, 3.3.1, 3.7.4, 6.1.1, 8.3.2, 9.5.2, 10.3.2, 15.1.6
 Concealed or Unknown Conditions, Claims for
 3.7.4
 Claims for Damages
 3.2.4, 3.18, 8.3.3, 9.5.1, 9.6.7, 10.2.5, 10.3.3, 11.3,
 11.3.2, 14.2.4, 15.1.7
 Claims Subject to Arbitration
 15.4.1
 Cleaning Up
 3.15, 6.3
 Commencement of the Work, Conditions Relating to
 2.2.1, 3.2.2, 3.4.1, 3.7.1, 3.10.1, 3.12.6, 5.2.1, 5.2.3,
 6.2.2, 8.1.2, 8.2.2, 8.3.1, 11.1, 11.2, 15.1.5
 Commencement of the Work, Definition of
 8.1.2
 Communications
 3.9.1, 4.2.4
 Completion, Conditions Relating to
 3.4.1, 3.11, 3.15, 4.2.2, 4.2.9, 8.2, 9.4.2, 9.8, 9.9.1,
 9.10, 12.2, 14.1.2, 15.1.2
 COMPLETION, PAYMENTS AND
 9
 Completion, Substantial
 3.10.1, 4.2.9, 8.1.1, 8.1.3, 8.2.3, 9.4.2, 9.8, 9.9.1,
 9.10.3, 12.2, 15.1.2
 Compliance with Laws
 2.3.2, 3.2.3, 3.6, 3.7, 3.12.10, 3.13, 9.6.4, 10.2.2,
 13.1, 13.3, 13.4.1, 13.4.2, 13.5, 14.1.1, 14.2.1.3,
 15.2.8, 15.4.2, 15.4.3
 Concealed or Unknown Conditions
 3.7.4, 4.2.8, 8.3.1, 10.3
 Conditions of the Contract
 1.1.1, 6.1.1, 6.1.4
 Consent, Written
 3.4.2, 3.14.2, 4.1.2, 9.8.5, 9.9.1, 9.10.2, 9.10.3, 13.2,
 15.4.4.2
 Consolidation or Joinder
 15.4.4
 CONSTRUCTION BY OWNER OR BY
 SEPARATE CONTRACTORS
 1.1.4, 6
 Construction Change Directive, Definition of
 7.3.1
 Construction Change Directives
 1.1.1, 3.4.2, 3.11, 3.12.8, 4.2.8, 7.1.1, 7.1.2, 7.1.3,
 7.3, 9.3.1.1
 Construction Schedules, Contractor's
 3.10, 3.11, 3.12.1, 3.12.2, 6.1.3, 15.1.6.2
 Contingent Assignment of Subcontracts
 5.4, 14.2.2.2
 Continuing Contract Performance
 15.1.4
 Contract, Definition of
 1.1.2
 CONTRACT, TERMINATION OR SUSPENSION
 OF THE
 5.4.1.1, 5.4.2, 11.5, 14
 Contract Administration
 3.1.3, 4, 9.4, 9.5
 Contract Award and Execution, Conditions Relating
 to
 3.7.1, 3.10, 5.2, 6.1
 Contract Documents, Copies Furnished and Use of
 1.5.2, 2.3.6, 5.3
 Contract Documents, Definition of
 1.1.1
 Contract Sum
 2.2.2, 2.2.4, 3.7.4, 3.7.5, 3.8, 3.10.2, 5.2.3, 7.3, 7.4,
 9.1, 9.2, 9.4.2, 9.5.1.4, 9.6.7, 9.7, 10.3.2, 11.5, 12.1.2,
 12.3, 14.2.4, 14.3.2, 15.1.4.2, 15.1.5, 15.2.5
 Contract Sum, Definition of
 9.1
 Contract Time
 1.1.4, 2.2.1, 2.2.2, 3.7.4, 3.7.5, 3.10.2, 5.2.3, 6.1.5,
 7.2.1.3, 7.3.1, 7.3.5, 7.3.6, 7, 7, 7.3.10, 7.4, 8.1.1,
 8.2.1, 8.2.3, 8.3.1, 9.5.1, 9.7, 10.3.2, 12.1.1, 12.1.2,
 14.3.2, 15.1.4.2, 15.1.6.1, 15.2.5
 Contract Time, Definition of
 8.1.1
 CONTRACTOR
 3
 Contractor, Definition of
 3.1, 6.1.2
 Contractor's Construction and Submittal Schedules
 3.10, 3.12.1, 3.12.2, 4.2.3, 6.1.3, 15.1.6.2
 Contractor's Employees

2.2.4, 3.3.2, 3.4.3, 3.8.1, 3.9, 3.18.2, 4.2.3, 4.2.6,
10.2, 10.3, 11.3, 14.1, 14.2.1.1
Contractor's Liability Insurance
11.1
Contractor's Relationship with Separate Contractors
and Owner's Forces
3.12.5, 3.14.2, 4.2.4, 6, 11.3, 12.2.4
Contractor's Relationship with Subcontractors
1.2.2, 2.2.4, 3.3.2, 3.18.1, 3.18.2, 4.2.4, 5, 9.6.2,
9.6.7, 9.10.2, 11.2, 11.3, 11.4
Contractor's Relationship with the Architect
1.1.2, 1.5, 2.3.3, 3.1.3, 3.2.2, 3.2.3, 3.2.4, 3.3.1, 3.4.2,
3.5.1, 3.7.4, 3.10, 3.11, 3.12, 3.16, 3.18, 4.2, 5.2,
6.2.2, 7, 8.3.1, 9.2, 9.3, 9.4, 9.5, 9.7, 9.8, 9.9, 10.2.6,
10.3, 11.3, 12, 13.4, 15.1.3, 15.2.1
Contractor's Representations
3.2.1, 3.2.2, 3.5, 3.12.6, 6.2.2, 8.2.1, 9.3.3, 9.8.2
Contractor's Responsibility for Those Performing the
Work
3.3.2, 3.18, 5.3, 6.1.3, 6.2, 9.5.1, 10.2.8
Contractor's Review of Contract Documents
3.2
Contractor's Right to Stop the Work
2.2.2, 9.7
Contractor's Right to Terminate the Contract
14.1
Contractor's Submittals
3.10, 3.11, 3.12, 4.2.7, 5.2.1, 5.2.3, 9.2, 9.3, 9.8.2,
9.8.3, 9.9.1, 9.10.2, 9.10.3
Contractor's Superintendent
3.9, 10.2.6
Contractor's Supervision and Construction
Procedures
1.2.2, 3.3, 3.4, 3.12.10, 4.2.2, 4.2.7, 6.1.3, 6.2.4,
7.1.3, 7.3.4, 7.3.6, 8.2, 10, 12, 14, 15.1.4
Coordination and Correlation
1.2, 3.2.1, 3.3.1, 3.10, 3.12.6, 6.1.3, 6.2.1
Copies Furnished of Drawings and Specifications
1.5, 2.3.6, 3.11
Copyrights
1.5, 3.17
Correction of Work
2.5, 3.7.3, 9.4.2, 9.8.2, 9.8.3, 9.9.1, 12.1.2, 12.2, 12.3,
15.1.3.1, 15.1.3.2, 15.2.1
Correlation and Intent of the Contract Documents
1.2
Cost, Definition of
7.3.4
Costs
2.5, 3.2.4, 3.7.3, 3.8.2, 3.15.2, 5.4.2, 6.1.1, 6.2.3,
7.3.3.3, 7.3.4, 7.3.8, 7.3.9, 9.10.2, 10.3.2, 10.3.6,
11.2, 12.1.2, 12.2.1, 12.2.4, 13.4, 14
Cutting and Patching
3.14, 6.2.5
Damage to Construction of Owner or Separate
Contractors
3.14.2, 6.2.4, 10.2.1.2, 10.2.5, 10.4, 12.2.4

Damage to the Work
3.14.2, 9.9.1, 10.2.1.2, 10.2.5, 10.4, 12.2.4
Damages, Claims for
3.2.4, 3.18, 6.1.1, 8.3.3, 9.5.1, 9.6.7, 10.3.3, 11.3.2,
11.3, 14.2.4, 15.1.7
Damages for Delay
6.2.3, 8.3.3, 9.5.1.6, 9.7, 10.3.2, 14.3.2
Date of Commencement of the Work, Definition of
8.1.2
Date of Substantial Completion, Definition of
8.1.3
Day, Definition of
8.1.4
Decisions of the Architect
3.7.4, 4.2.6, 4.2.7, 4.2.11, 4.2.12, 4.2.13, 6.3, 7.3.4,
7.3.9, 8.1.3, 8.3.1, 9.2, 9.4, 9.5.1, 9.8.4, 9.9.1, 13.4.2,
14.2.2, 14.2.4, 15.1, 15.2
Decisions to Withhold Certification
9.4.1, 9.5, 9.7, 14.1.1.3
Defective or Nonconforming Work, Acceptance,
Rejection and Correction of
2.5, 3.5, 4.2.6, 6.2.3, 9.5.1, 9.5.3, 9.6.6, 9.8.2, 9.9.3,
9.10.4, 12.2.1
Definitions
1.1, 2.1.1, 3.1.1, 3.5, 3.12.1, 3.12.2, 3.12.3, 4.1.1, 5.1,
6.1.2, 7.2.1, 7.3.1, 8.1, 9.1, 9.8.1, 15.1.1
Delays and Extensions of Time
3.2, 3.7.4, 5.2.3, 7.2.1, 7.3.1, 7.4, 8.3, 9.5.1, 9.7,
10.3.2, 10.4, 14.3.2, 15.1.6, 15.2.5
Digital Data Use and Transmission
1.7
Disputes
6.3, 7.3.9, 15.1, 15.2
Documents and Samples at the Site
3.11
Drawings, Definition of
1.1.5
Drawings and Specifications, Use and Ownership of
3.11
Effective Date of Insurance
8.2.2
Emergencies
10.4, 14.1.1.2, 15.1.5
Employees, Contractor's
3.3.2, 3.4.3, 3.8.1, 3.9, 3.18.2, 4.2.3, 4.2.6, 10.2,
10.3.3, 11.3, 14.1, 14.2.1.1
Equipment, Labor, or Materials
1.1.3, 1.1.6, 3.4, 3.5, 3.8.2, 3.8.3, 3.12, 3.13, 3.15.1,
4.2.6, 4.2.7, 5.2.1, 6.2.1, 7.3.4, 9.3.2, 9.3.3, 9.5.1.3,
9.10.2, 10.2.1, 10.2.4, 14.2.1.1, 14.2.1.2
Execution and Progress of the Work
1.1.3, 1.2.1, 1.2.2, 2.3.4, 2.3.6, 3.1, 3.3.1, 3.4.1, 3.7.1,
3.10.1, 3.12, 3.14, 4.2, 6.2.2, 7.1.3, 7.3.6, 8.2, 9.5.1,
9.9.1, 10.2, 10.3, 12.1, 12.2, 14.2, 14.3.1, 15.1.4
Extensions of Time
3.2.4, 3.7.4, 5.2.3, 7.2.1, 7.3, 7.4, 9.5.1, 9.7, 10.3.2,
10.4, 14.3, 15.1.6, 15.2.5

Failure of Payment
 9.5.1.3, 9.7, 9.10.2, 13.5, 14.1.1.3, 14.2.1.2
 Faulty Work
 (See Defective or Nonconforming Work)
 Final Completion and Final Payment
 4.2.1, 4.2.9, 9.8.2, 9.10, 12.3, 14.2.4, 14.4.3
 Financial Arrangements, Owner's
 2.2.1, 13.2.2, 14.1.1.4
 GENERAL PROVISIONS
 1
 Governing Law
 13.1
 Guarantees (See Warranty)
 Hazardous Materials and Substances
 10.2.4, 10.3
 Identification of Subcontractors and Suppliers
 5.2.1
 Indemnification
 3.17, 3.18, 9.6.8, 9.10.2, 10.3.3, 11.3
 Information and Services Required of the Owner
 2.1.2, 2.2, 2.3, 3.2.2, 3.12.10.1, 6.1.3, 6.1.4, 6.2.5,
 9.6.1, 9.9.2, 9.10.3, 10.3.3, 11.2, 13.4.1, 13.4.2,
 14.1.1.4, 14.1.4, 15.1.4
 Initial Decision
 15.2
 Initial Decision Maker, Definition of
 1.1.8
 Initial Decision Maker, Decisions
 14.2.4, 15.1.4.2, 15.2.1, 15.2.2, 15.2.3, 15.2.4, 15.2.5
 Initial Decision Maker, Extent of Authority
 14.2.4, 15.1.4.2, 15.2.1, 15.2.2, 15.2.3, 15.2.4, 15.2.5
 Injury or Damage to Person or Property
 10.2.8, 10.4
 Inspections
 3.1.3, 3.3.3, 3.7.1, 4.2.2, 4.2.6, 4.2.9, 9.4.2, 9.8.3,
 9.9.2, 9.10.1, 12.2.1, 13.4
 Instructions to Bidders
 1.1.1
 Instructions to the Contractor
 3.2.4, 3.3.1, 3.8.1, 5.2.1, 7, 8.2.2, 12, 13.4.2
 Instruments of Service, Definition of
 1.1.7
 Insurance
 6.1.1, 7.3.4, 8.2.2, 9.3.2, 9.8.4, 9.9.1, 9.10.2, 10.2.5,
 11
Insurance, Notice of Cancellation or Expiration
11.1.4, 11.2.3
 Insurance, Contractor's Liability
 11.1
 Insurance, Effective Date of
 8.2.2, 14.4.2
 Insurance, Owner's Liability
 11.2
 Insurance, Property
 10.2.5, 11.2, 11.4, 11.5
 Insurance, Stored Materials
 9.3.2

INSURANCE AND BONDS
 11
 Insurance Companies, Consent to Partial Occupancy
 9.9.1
 Insured loss, Adjustment and Settlement of
 11.5
 Intent of the Contract Documents
 1.2.1, 4.2.7, 4.2.12, 4.2.13
 Interest
 13.5
 Interpretation
 1.1.8, 1.2.3, 1.4, 4.1.1, 5.1, 6.1.2, 15.1.1
 Interpretations, Written
 4.2.11, 4.2.12
 Judgment on Final Award
 15.4.2
 Labor and Materials, Equipment
 1.1.3, 1.1.6, 3.4, 3.5, 3.8.2, 3.8.3, 3.12, 3.13, 3.15.1,
 5.2.1, 6.2.1, 7.3.4, 9.3.2, 9.3.3, 9.5.1.3, 9.10.2, 10.2.1,
 10.2.4, 14.2.1.1, 14.2.1.2
 Labor Disputes
 8.3.1
 Laws and Regulations
 1.5, 2.3.2, 3.2.3, 3.2.4, 3.6, 3.7, 3.12.10, 3.13, 9.6.4,
 9.9.1, 10.2.2, 13.1, 13.3.1, 13.4.2, 13.5, 14, 15.2.8,
 15.4
 Liens
 2.1.2, 9.3.1, 9.3.3, 9.6.8, 9.10.2, 9.10.4, 15.2.8
 Limitations, Statutes of
 12.2.5, 15.1.2, 15.4.1.1
 Limitations of Liability
 3.2.2, 3.5, 3.12.10, 3.12.10.1, 3.17, 3.18.1, 4.2.6,
 4.2.7, 6.2.2, 9.4.2, 9.6.4, 9.6.7, 9.6.8, 10.2.5, 10.3.3,
 11.3, 12.2.5, 13.3.1
 Limitations of Time
 2.1.2, 2.2, 2.5, 3.2.2, 3.10, 3.11, 3.12.5, 3.15.1, 4.2.7,
 5.2, 5.3, 5.4.1, 6.2.4, 7.3, 7.4, 8.2, 9.2, 9.3.1, 9.3.3,
 9.4.1, 9.5, 9.6, 9.7, 9.8, 9.9, 9.10, 12.2, 13.4, 14, 15,
 15.1.2, 15.1.3, 15.1.5
 Materials, Hazardous
 10.2.4, 10.3
 Materials, Labor, Equipment and
 1.1.3, 1.1.6, 3.4.1, 3.5, 3.8.2, 3.8.3, 3.12, 3.13, 3.15.1,
 5.2.1, 6.2.1, 7.3.4, 9.3.2, 9.3.3, 9.5.1.3, 9.10.2,
 10.2.1.2, 10.2.4, 14.2.1.1, 14.2.1.2
 Means, Methods, Techniques, Sequences and
 Procedures of Construction
 3.3.1, 3.12.10, 4.2.2, 4.2.7, 9.4.2
 Mechanic's Lien
 2.1.2, 9.3.1, 9.3.3, 9.6.8, 9.10.2, 9.10.4, 15.2.8
 Mediation
 8.3.1, 15.1.3.2, 15.2.1, 15.2.5, 15.2.6, 15.3, 15.4.1,
 15.4.1.1
 Minor Changes in the Work
 1.1.1, 3.4.2, 3.12.8, 4.2.8, 7.1, 7.4
 MISCELLANEOUS PROVISIONS
 13

Modifications, Definition of
1.1.1
Modifications to the Contract
1.1.1, 1.1.2, 2.5, 3.11, 4.1.2, 4.2.1, 5.2.3, 7, 8.3.1, 9.7, 10.3.2
Mutual Responsibility
6.2
Nonconforming Work, Acceptance of
9.6.6, 9.9.3, 12.3
Nonconforming Work, Rejection and Correction of
2.4, 2.5, 3.5, 4.2.6, 6.2.4, 9.5.1, 9.8.2, 9.9.3, 9.10.4, 12.2
Notice
1.6, 1.6.1, 1.6.2, 2.1.2, 2.2.2, 2.2.3, 2.2.4, 2.5, 3.2.4, 3.3.1, 3.7.4, 3.7.5, 3.9.2, 3.12.9, 3.12.10, 5.2.1, 7.4, 8.2.2, 9.6.8, 9.7, 9.10.1, 10.2.8, 10.3.2, 11.5, 12.2.2.1, 13.4.1, 13.4.2, 14.1, 14.2.2, 14.4.2, 15.1.3, 15.1.5, 15.1.6, 15.4.1
Notice of Cancellation or Expiration of Insurance
11.1.4, 11.2.3
Notice of Claims
1.6.2, 2.1.2, 3.7.4, 9.6.8, 10.2.8, 15.1.3, 15.1.5, 15.1.6, 15.2.8, 15.3.2, 15.4.1
Notice of Testing and Inspections
13.4.1, 13.4.2
Observations, Contractor's
3.2, 3.7.4
Occupancy
2.3.1, 9.6.6, 9.8
Orders, Written
1.1.1, 2.4, 3.9.2, 7, 8.2.2, 11.5, 12.1, 12.2.2.1, 13.4.2, 14.3.1
OWNER
2
Owner, Definition of
2.1.1
Owner, Evidence of Financial Arrangements
2.2, 13.2.2, 14.1.1.4
Owner, Information and Services Required of the
2.1.2, 2.2, 2.3, 3.2.2, 3.12.10, 6.1.3, 6.1.4, 6.2.5, 9.3.2, 9.6.1, 9.6.4, 9.9.2, 9.10.3, 10.3.3, 11.2, 13.4.1, 13.4.2, 14.1.1.4, 14.1.4, 15.1.4
Owner's Authority
1.5, 2.1.1, 2.3.32.4, 2.5, 3.4.2, 3.8.1, 3.12.10, 3.14.2, 4.1.2, 4.2.4, 4.2.9, 5.2.1, 5.2.4, 5.4.1, 6.1, 6.3, 7.2.1, 7.3.1, 8.2.2, 8.3.1, 9.3.2, 9.5.1, 9.6.4, 9.9.1, 9.10.2, 10.3.2, 11.4, 11.5, 12.2.2, 12.3, 13.2.2, 14.3, 14.4, 15.2.7
Owner's Insurance
11.2
Owner's Relationship with Subcontractors
1.1.2, 5.2, 5.3, 5.4, 9.6.4, 9.10.2, 14.2.2
Owner's Right to Carry Out the Work
2.5, 14.2.2
Owner's Right to Clean Up
6.3
Owner's Right to Perform Construction and to Award

Separate Contracts
6.1
Owner's Right to Stop the Work
2.4
Owner's Right to Suspend the Work
14.3
Owner's Right to Terminate the Contract
14.2, 14.4
Ownership and Use of Drawings, Specifications and Other Instruments of Service
1.1.1, 1.1.6, 1.1.7, 1.5, 2.3.6, 3.2.2, 3.11, 3.17, 4.2.12, 5.3
Partial Occupancy or Use
9.6.6, 9.9
Patching, Cutting and
3.14, 6.2.5
Patents
3.17
Payment, Applications for
4.2.5, 7.3.9, 9.2, 9.3, 9.4, 9.5, 9.6.3, 9.7, 9.8.5, 9.10.1, 14.2.3, 14.2.4, 14.4.3
Payment, Certificates for
4.2.5, 4.2.9, 9.3.3, 9.4, 9.5, 9.6.1, 9.6.6, 9.7, 9.10.1, 9.10.3, 14.1.1.3, 14.2.4
Payment, Failure of
9.5.1.3, 9.7, 9.10.2, 13.5, 14.1.1.3, 14.2.1.2
Payment, Final
4.2.1, 4.2.9, 9.10, 12.3, 14.2.4, 14.4.3
Payment Bond, Performance Bond and
7.3.4.4, 9.6.7, 9.10.3, 11.1.2
Payments, Progress
9.3, 9.6, 9.8.5, 9.10.3, 14.2.3, 15.1.4
PAYMENTS AND COMPLETION
9
Payments to Subcontractors
5.4.2, 9.5.1.3, 9.6.2, 9.6.3, 9.6.4, 9.6.7, 14.2.1.2
PCB
10.3.1
Performance Bond and Payment Bond
7.3.4.4, 9.6.7, 9.10.3, 11.1.2
Permits, Fees, Notices and Compliance with Laws
2.3.1, 3.7, 3.13, 7.3.4.4, 10.2.2
PERSONS AND PROPERTY, PROTECTION OF
10
Polychlorinated Biphenyl
10.3.1
Product Data, Definition of
3.12.2
Product Data and Samples, Shop Drawings
3.11, 3.12, 4.2.7
Progress and Completion
4.2.2, 8.2, 9.8, 9.9.1, 14.1.4, 15.1.4
Progress Payments
9.3, 9.6, 9.8.5, 9.10.3, 14.2.3, 15.1.4
Project, Definition of
1.1.4
Project Representatives

Init.

4.2.10
 Property Insurance
 10.2.5, 11.2
 Proposal Requirements
 1.1.1
PROTECTION OF PERSONS AND PROPERTY
 10
 Regulations and Laws
 1.5, 2.3.2, 3.2.3, 3.6, 3.7, 3.12.10, 3.13, 9.6.4, 9.9.1,
 10.2.2, 13.1, 13.3, 13.4.1, 13.4.2, 13.5, 14, 15.2.8,
 15.4
 Rejection of Work
 4.2.6, 12.2.1
 Releases and Waivers of Liens
 9.3.1, 9.10.2
 Representations
 3.2.1, 3.5, 3.12.6, 8.2.1, 9.3.3, 9.4.2, 9.5.1, 9.10.1
 Representatives
 2.1.1, 3.1.1, 3.9, 4.1.1, 4.2.10, 13.2.1
 Responsibility for Those Performing the Work
 3.3.2, 3.18, 4.2.2, 4.2.3, 5.3, 6.1.3, 6.2, 6.3, 9.5.1, 10
 Retainage
 9.3.1, 9.6.2, 9.8.5, 9.9.1, 9.10.2, 9.10.3
 Review of Contract Documents and Field Conditions
 by Contractor
 3.2, 3.12.7, 6.1.3
 Review of Contractor's Submittals by Owner and
 Architect
 3.10.1, 3.10.2, 3.11, 3.12, 4.2, 5.2, 6.1.3, 9.2, 9.8.2
 Review of Shop Drawings, Product Data and
 Samples by Contractor
 3.12
 Rights and Remedies
 1.1.2, 2.4, 2.5, 3.5, 3.7.4, 3.15.2, 4.2.6, 5.3, 5.4, 6.1,
 6.3, 7.3.1, 8.3, 9.5.1, 9.7, 10.2.5, 10.3, 12.2.1, 12.2.2,
 12.2.4, 13.3, 14, 15.4
 Royalties, Patents and Copyrights
 3.17
 Rules and Notices for Arbitration
 15.4.1
 Safety of Persons and Property
 10.2, 10.4
 Safety Precautions and Programs
 3.3.1, 4.2.2, 4.2.7, 5.3, 10.1, 10.2, 10.4
 Samples, Definition of
 3.12.3
 Samples, Shop Drawings, Product Data and
 3.11, 3.12, 4.2.7
 Samples at the Site, Documents and
 3.11
 Schedule of Values
 9.2, 9.3.1
 Schedules, Construction
 3.10, 3.12.1, 3.12.2, 6.1.3, 15.1.6.2
 Separate Contracts and Contractors
 1.1.4, 3.12.5, 3.14.2, 4.2.4, 4.2.7, 6, 8.3.1, 12.1.2
 Separate Contractors, Definition of

6.1.1
 Shop Drawings, Definition of
 3.12.1
 Shop Drawings, Product Data and Samples
 3.11, 3.12, 4.2.7
 Site, Use of
 3.13, 6.1.1, 6.2.1
 Site Inspections
 3.2.2, 3.3.3, 3.7.1, 3.7.4, 4.2, 9.9.2, 9.4.2, 9.10.1, 13.4
 Site Visits, Architect's
 3.7.4, 4.2.2, 4.2.9, 9.4.2, 9.5.1, 9.9.2, 9.10.1, 13.4
 Special Inspections and Testing
 4.2.6, 12.2.1, 13.4
 Specifications, Definition of
 1.1.6
 Specifications
 1.1.1, 1.1.6, 1.2.2, 1.5, 3.12.10, 3.17, 4.2.14
 Statute of Limitations
 15.1.2, 15.4.1.1
 Stopping the Work
 2.2.2, 2.4, 9.7, 10.3, 14.1
 Stored Materials
 6.2.1, 9.3.2, 10.2.1.2, 10.2.4
 Subcontractor, Definition of
 5.1.1
SUBCONTRACTORS
 5
 Subcontractors, Work by
 1.2.2, 3.3.2, 3.12.1, 3.18, 4.2.3, 5.2.3, 5.3, 5.4,
 9.3.1.2, 9.6.7
 Subcontractual Relations
 5.3, 5.4, 9.3.1.2, 9.6, 9.10, 10.2.1, 14.1, 14.2.1
 Submittals
 3.10, 3.11, 3.12, 4.2.7, 5.2.1, 5.2.3, 7.3.4, 9.2, 9.3,
 9.8, 9.9.1, 9.10.2, 9.10.3
 Submittal Schedule
 3.10.2, 3.12.5, 4.2.7
 Subrogation, Waivers of
 6.1.1, 11.3
 Substances, Hazardous
 10.3
 Substantial Completion
 4.2.9, 8.1.1, 8.1.3, 8.2.3, 9.4.2, 9.8, 9.9.1, 9.10.3,
 12.2, 15.1.2
 Substantial Completion, Definition of
 9.8.1
 Substitution of Subcontractors
 5.2.3, 5.2.4
 Substitution of Architect
 2.3.3
 Substitutions of Materials
 3.4.2, 3.5, 7.3.8
 Sub-subcontractor, Definition of
 5.1.2
 Subsurface Conditions
 3.7.4
 Successors and Assigns

13.2
 Superintendent
 3.9, 10.2.6
 Supervision and Construction Procedures
 1.2.2, 3.3, 3.4, 3.12.10, 4.2.2, 4.2.7, 6.1.3, 6.2.4,
 7.1.3, 7.3.4, 8.2, 8.3.1, 9.4.2, 10, 12, 14, 15.1.4
 Suppliers
 1.5, 3.12.1, 4.2.4, 4.2.6, 5.2.1, 9.3, 9.4.2, 9.5.4, 9.6,
 9.10.5, 14.2.1
 Surety
 5.4.1.2, 9.6.8, 9.8.5, 9.10.2, 9.10.3, 11.1.2, 14.2.2,
 15.2.7
 Surety, Consent of
 9.8.5, 9.10.2, 9.10.3
 Surveys
 1.1.7, 2.3.4
 Suspension by the Owner for Convenience
 14.3
 Suspension of the Work
 3.7.5, 5.4.2, 14.3
 Suspension or Termination of the Contract
 5.4.1.1, 14
 Taxes
 3.6, 3.8.2.1, 7.3.4.4
 Termination by the Contractor
 14.1, 15.1.7
 Termination by the Owner for Cause
 5.4.1.1, 14.2, 15.1.7
 Termination by the Owner for Convenience
 14.4
 Termination of the Architect
 2.3.3
 Termination of the Contractor Employment
 14.2.2

TERMINATION OR SUSPENSION OF THE CONTRACT

14
 Tests and Inspections
 3.1.3, 3.3.3, 3.7.1, 4.2.2, 4.2.6, 4.2.9, 9.4.2, 9.8.3,
 9.9.2, 9.10.1, 10.3.2, 12.2.1, 13.4
 TIME
 8
 Time, Delays and Extensions of
 3.2.4, 3.7.4, 5.2.3, 7.2.1, 7.3.1, 7.4, 8.3, 9.5.1, 9.7,
 10.3.2, 10.4, 14.3.2, 15.1.6, 15.2.5
 Time Limits

2.1.2, 2.2, 2.5, 3.2.2, 3.10, 3.11, 3.12.5, 3.15.1, 4.2,
 5.2, 5.3, 5.4, 6.2.4, 7.3, 7.4, 8.2, 9.2, 9.3.1, 9.3.3,
 9.4.1, 9.5, 9.6, 9.7, 9.8, 9.9, 9.10, 12.2, 13.4, 14,
 15.1.2, 15.1.3, 15.4
 Time Limits on Claims
 3.7.4, 10.2.8, 15.1.2, 15.1.3
 Title to Work
 9.3.2, 9.3.3
 UNCOVERING AND CORRECTION OF WORK
 12
 Uncovering of Work
 12.1
 Unforeseen Conditions, Concealed or Unknown
 3.7.4, 8.3.1, 10.3
 Unit Prices
 7.3.3.2, 9.1.2
 Use of Documents
 1.1.1, 1.5, 2.3.6, 3.12.6, 5.3
 Use of Site
 3.13, 6.1.1, 6.2.1
 Values, Schedule of
 9.2, 9.3.1
 Waiver of Claims by the Architect
 13.3.2
 Waiver of Claims by the Contractor
 9.10.5, 13.3.2, 15.1.7
 Waiver of Claims by the Owner
 9.9.3, 9.10.3, 9.10.4, 12.2.2.1, 13.3.2, 14.2.4, 15.1.7
 Waiver of Consequential Damages
 14.2.4, 15.1.7
 Waiver of Liens
 9.3, 9.10.2, 9.10.4
 Waivers of Subrogation
 6.1.1, 11.3
 Warranty
 3.5, 4.2.9, 9.3.3, 9.8.4, 9.9.1, 9.10.2, 9.10.4, 12.2.2,
 15.1.2
 Weather Delays
 8.3, 15.1.6.2
 Work, Definition of
 1.1.3
 Written Consent
 1.5.2, 3.4.2, 3.7.4, 3.12.8, 3.14.2, 4.1.2, 9.3.2, 9.10.3,
 13.2, 13.3.2, 15.4.4.2
 Written Interpretations
 4.2.11, 4.2.12
 Written Orders
 1.1.1, 2.4, 3.9, 7, 8.2.2, 12.1, 12.2, 13.4.2, 14.3.1

ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents

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

§ 1.1.2 The Contract

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

§ 1.1.3 The Work

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

§ 1.1.4 The Project

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

§ 1.1.5 The Drawings

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

§ 1.1.6 The Specifications

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

§ 1.1.7 Instruments of Service

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

§ 1.1.8 Initial Decision Maker

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

§ 1.2 Correlation and Intent of the Contract Documents

§ 1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent

consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

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

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

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

§ 1.3 Capitalization

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

§ 1.4 Interpretation

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

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

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

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

§ 1.6 Notice

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

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

§ 1.7 Digital Data Use and Transmission

The parties shall agree upon protocols governing the transmission and use of Instruments of Service or any other information or documentation in digital form. The parties will use AIA Document E203™-2013, Building Information Modeling and Digital Data Exhibit, to establish the protocols for the development, use, transmission, and exchange of digital data.

§ 1.8 Building Information Models Use and Reliance

Any use of, or reliance on, all or a portion of a building information model without agreement to protocols governing the use of, and reliance on, the information contained in the model and without having those protocols set forth in AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document G202™–2013, Project Building Information Modeling Protocol Form, shall be at the using or relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.

ARTICLE 2 OWNER

§ 2.1 General

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

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

§ 2.2 Evidence of the Owner's Financial Arrangements

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

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

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

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

§ 2.3 Information and Services Required of the Owner

§ 2.3.1 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements,

assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

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

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

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

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

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

§ 2.4 Owner's Right to Stop the Work

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

§ 2.5 Owner's Right to Carry Out the Work

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

ARTICLE 3 CONTRACTOR

§ 3.1 General

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

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

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

§ 3.2 Review of Contract Documents and Field Conditions by Contractor

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

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.3.4, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

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

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

§ 3.3 Supervision and Construction Procedures

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

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

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

§ 3.4 Labor and Materials

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

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

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

§ 3.5 Warranty

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

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

§ 3.6 Taxes

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

§ 3.7 Permits, Fees, Notices and Compliance with Laws

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

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

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

§ 3.7.4 Concealed or Unknown Conditions

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

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

§ 3.8 Allowances

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

§ 3.8.2 Unless otherwise provided in the Contract Documents,

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

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

§ 3.9 Superintendent

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

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

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

§ 3.10 Contractor's Construction and Submittal Schedules

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

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

Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

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

§ 3.11 Documents and Samples at the Site

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

§ 3.12 Shop Drawings, Product Data and Samples

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

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

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

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

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

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

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

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

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

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

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

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

§ 3.13 Use of Site

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

§ 3.14 Cutting and Patching

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

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

§ 3.15 Cleaning Up

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

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

§ 3.16 Access to Work

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

§ 3.17 Royalties, Patents and Copyrights

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

§ 3.18 Indemnification

§ 3.18.1 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.

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

ARTICLE 4 ARCHITECT

§ 4.1 General

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

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

§ 4.2 Administration of the Contract

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

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

§ 4.2.3 On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner (1) known deviations from the

Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of, and will not be responsible for acts or omissions of, the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

§ 4.2.4 Communications

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

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

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

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

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

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

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

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

§ 4.2.12 Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations

and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either, and will not be liable for results of interpretations or decisions rendered in good faith.

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

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

ARTICLE 5 SUBCONTRACTORS

§ 5.1 Definitions

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

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

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

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

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

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

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

§ 5.3 Subcontractual Relations

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

prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

§ 5.4 Contingent Assignment of Subcontracts

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

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

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

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

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

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

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

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

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

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

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

§ 6.2 Mutual Responsibility

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

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a Separate Contractor, the Contractor shall, prior to proceeding with that portion of the Work,

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

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

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

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

§ 6.3 Owner's Right to Clean Up

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

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 General

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

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

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

§ 7.2 Change Orders

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

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

§ 7.3 Construction Change Directives

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

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

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

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

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

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

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

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

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

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

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

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

§ 7.4 Minor Changes in the Work

The Architect may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. The Architect's order for minor changes shall be in writing. If the Contractor believes that the proposed minor change in the Work will

affect the Contract Sum or Contract Time, the Contractor shall notify the Architect and shall not proceed to implement the change in the Work. If the Contractor performs the Work set forth in the Architect's order for a minor change without prior notice to the Architect that such change will affect the Contract Sum or Contract Time, the Contractor waives any adjustment to the Contract Sum or extension of the Contract Time.

ARTICLE 8 TIME

§ 8.1 Definitions

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

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

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

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

§ 8.2 Progress and Completion

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

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

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

§ 8.3 Delays and Extensions of Time

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

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

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

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum

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

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

§ 9.2 Schedule of Values

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

unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment.

§ 9.3 Applications for Payment

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

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

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

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

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

§ 9.4 Certificates for Payment

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

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

§ 9.5 Decisions to Withhold Certification

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

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

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

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

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

§ 9.6 Progress Payments

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

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

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

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

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

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

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

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

§ 9.7 Failure of Payment

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

§ 9.8 Substantial Completion

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

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

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

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

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

§ 9.9 Partial Occupancy or Use

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

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

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

§ 9.10 Final Completion and Final Payment

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

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

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

- § 9.10.4** The making of final payment shall constitute a waiver of Claims by the Owner except those arising from
- .1 liens, Claims, security interests, or encumbrances arising out of the Contract and unsettled;
 - .2 failure of the Work to comply with the requirements of the Contract Documents;
 - .3 terms of special warranties required by the Contract Documents; or
 - .4 audits performed by the Owner, if permitted by the Contract Documents, after final payment.

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

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 Safety Precautions and Programs

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

§ 10.2 Safety of Persons and Property

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

- .1 employees on the Work and other persons who may be affected thereby;
- .2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor; and
- .3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

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

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

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

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

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

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

§ 10.2.8 Injury or Damage to Person or Property

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

§ 10.3 Hazardous Materials and Substances

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

§ 10.3.2 Upon receipt of the Contractor's notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of the material or substance or who are to perform the task of removal or safe containment of the material or substance. The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable additional costs of shutdown, delay, and start-up.

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

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

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

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

§ 10.4 Emergencies

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

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 Contractor's Insurance and Bonds

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

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

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

§ 11.1.4 **Notice of Cancellation or Expiration of Contractor's Required Insurance.** Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by the Contract Documents, the Contractor shall provide notice to the Owner of such impending or actual cancellation or expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage.

§ 11.2 Owner's Insurance

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

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

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

§ 11.3 Waivers of Subrogation

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

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

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

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

§ 11.5 Adjustment and Settlement of Insured Loss

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

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

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work

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

§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, the Contractor shall be entitled to an equitable adjustment to

the Contract Sum and Contract Time as may be appropriate. If such Work is not in accordance with the Contract Documents, the costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense.

§ 12.2 Correction of Work

§ 12.2.1 Before Substantial Completion

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

§ 12.2.2 After Substantial Completion

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

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

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

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

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

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

§ 12.3 Acceptance of Nonconforming Work

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

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law

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

§ 13.2 Successors and Assigns

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

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

§ 13.3 Rights and Remedies

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

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

§ 13.4 Tests and Inspections

§ 13.4.1 Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

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

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

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

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

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

§ 13.5 Interest

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

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

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

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

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

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

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

§ 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

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

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

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

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

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance,

the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.3 Suspension by the Owner for Convenience

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

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

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

§ 14.4 Termination by the Owner for Convenience

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

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

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

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

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 Claims

§ 15.1.1 Definition

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

§ 15.1.2 Time Limits on Claims

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

§ 15.1.3 Notice of Claims

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

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

§ 15.1.4 Continuing Contract Performance

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

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

§ 15.1.5 Claims for Additional Cost

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

§ 15.1.6 Claims for Additional Time

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

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

§ 15.1.7 Waiver of Claims for Consequential Damages

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

- .1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and
- .2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit, except anticipated profit arising directly from the Work.

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

§ 15.2 Initial Decision

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

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

Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

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

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

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

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

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

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

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

§ 15.3 Mediation

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

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

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

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

§ 15.4 Arbitration

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

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

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

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

§ 15.4.4 Consolidation or Joinder

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

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

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

SECTION 00 73 13

SUPPLEMENTARY GENERAL CONDITIONS A201-2017

The following supplements modify the "General Conditions of the Contract for Construction," AIA Document A201-2017. Where a portion of the General Conditions is modified or deleted by the Supplementary Conditions, the unaltered portions of the General Conditions shall remain in effect.

TABLE OF ARTICLES

1. GENERAL PROVISIONS
2. OWNER
3. CONTRACTOR
4. ADMINISTRATION OF THE CONTRACT
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

ARTICLE 1: GENERAL PROVISIONS

1.1 BASIC DEFINITIONS

1.1.1 THE CONTRACT DOCUMENTS

Strike the last sentence of Section 1.1.1 in its entirety and replace with the following:

“The Contract Documents also include Advertisement for Bid, Instructions to Bidder, sample forms, the Bid Form, the Contractor’s completed Bid and the Award Letter.”

Add the following Section:

“1.1.1.1 In the event of conflict or discrepancies among the Contract Documents, the Documents prepared by the State of Delaware, Division of Facilities Management shall take precedence over all other documents.”

1.1.8 INITIAL DECISION MAKER

Strike the last sentence of Section 1.1.8 in its entirety and add the following to the end of the remaining sentence:

“ and certify termination of the Agreement under Section 14.2.2.”

1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

1.2.1.1 Insert “if possible” at the end of the second sentence.

Add the following Sections:

“1.2.4 In the case of an inconsistency between the Drawings and the Specifications, or within either document not clarified by addendum, the better quality or greater quantity of work shall be provided in accordance with the Architect’s interpretation.”

“1.2.5The word “PROVIDE” as used in the Contract Documents shall mean “FURNISH AND INSTALL” and shall include, without limitation, all labor, materials, equipment, transportation, services and other items required to complete the Work.”

“1.2.6The word “PRODUCT” as used in the Contract Documents means all materials, systems and equipment.”

1.5 OWNERSHIP AND USE OF DRAWINGS, SPECIFICATIONS AND OTHER INSTRUMENTS OF SERVICE

Strike Section 1.5.1 in its entirety and replace with the following:

“All pre-design studies, drawings, specifications and other documents, including those in electronic form, prepared by the Architect under this Agreement are, and shall remain, the property of the Owner whether the Project for which they are made is executed or not. Such documents may be used by the Owner to construct one or more like Projects without the approval of, or additional compensation to, the Architect. The Contractor, Subcontractors, Sub-subcontractors, and Material or Equipment Suppliers are authorized to use and reproduce applicable portions of the Drawings, Specifications and other documents prepared by the Architect and the Architect’s consultants appropriate to and for use in the execution of their Work under the Contract Documents. They are not to be used by the Contractor or any Subcontractor, Sub-subcontractor or Material and Equipment Supplier on other Projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner, Architect and Architect’s consultants.

The Architect shall not be liable for injury or damage resulting from the re-use of drawings and specifications if the Architect is not involved in the re-use Project. Prior to re-use of construction documents for a Project in which the Architect is not also involved, the Owner will remove from such documents all identification of the original Architect, including name, address and professional seal or stamp.”

Strike Section 1.5.2 in its entirety.

1.7 DIGITAL DATA USE AND TRANSMISSION

Strike Section 1.7 in its entirety and replace with the following:

“The parties shall agree upon protocols governing transmission and use of Instruments of Service or any other information or documentation in digital form.”

1.8 BUILDING INFORMATION MODELS USE AND RELIANCE

Strike Section 1.8 in its entirety.

ARTICLE 2: OWNER

2.2 EVIDENCE OF THE OWNERS FINANCIAL ARRANGEMENTS

Strike Section 2.2 in its entirety.

2.3 INFORMATION AND SERVICES REQUIRED OF THE OWNER

2.3.3 Strike 2.3.3 in its entirety.

2.3.4 Add the following sentence at the end of the paragraph:

“The Contractor, at their expense shall bear the costs to accurately identify the location of all underground utilities in the area of their excavation and shall bear all cost for any repairs required, out of failure to accurately identify said utilities.”

Strike Section 2.3.6 in its entirety and replace with the following:

“2.3.6The Contractor shall be furnished free of charge (1) electronic set of the Drawings and Project Manuals. Additional sets will be furnished at the cost of reproduction, postage and handling.”

2.5 OWNER’S RIGHT TO CARRY OUT THE WORK

Add “, except as outlined in Section 3.15” after the reference to “Article 15” at the end of the last sentence of the Section.

ARTICLE 3: CONTRACTOR

3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

3.2.2 Add “and Owner” after “report to the Architect” in the second sentence.

3.2.4 Strike “subject to Section 15.1.7” in the second sentence.

3.2.4 Strike the third sentence.

3.3 SUPERVISION AND CONSTRUCTION PROCEDURES

Add the following Sections:

“3.3.2.1 The Contractor shall immediately remove from the Work, whenever requested to do so by the Owner, any person who is considered by the Owner or Architect to be incompetent or disposed to be so disorderly, or who for any reason is not satisfactory to the Owner, and that person shall not again be employed on the Work without the consent of the Owner or the Architect.”

“3.3.4The Contractor must provide suitable storage facilities at the Site for the proper protection and safe storage of their materials, or as otherwise identified by the specifications. Consult the Owner and the Architect before storing any materials.”

“3.3.5When any room is used as a shop, storeroom, office, etc., by the Contractor or Subcontractor(s) during the construction of the Work, the Contractor making use of these areas will be held responsible for any repairs, patching or cleaning arising from such use.”

3.4 LABOR AND MATERIALS

Add the Following Sections:

“3.4.4Before starting the Work, each Contractor shall carefully examine all preparatory Work that has been executed to receive their Work. Check carefully, by whatever means are required, to insure that its Work and adjacent, related Work, will finish to proper contours, planes and

levels. Promptly notify the Architect & Owner of any defects or imperfections in preparatory Work which will in any way affect satisfactory completion of its Work. Absence of such notification will be construed as an acceptance of preparatory Work and later claims of defects will not be recognized.”

“3.4.5 Under no circumstances shall the Contractor’s Work proceed prior to preparatory Work having been completely cured, dried and/or otherwise made satisfactory to receive this Work. Responsibility for timely installation of all materials rests solely with the Contractor responsible for that Work, who shall maintain coordination at all times.”

3.5 WARRANTY

Add the following Sections:

“3.5.3 The Contractor will guarantee all materials and workmanship against original defects, except injury from proper and usual wear when used for the purpose intended, for two years after Acceptance by the Owner, and will maintain all items in perfect condition during the period of warranty.”

“3.5.4 Defects appearing during the period of warranty will be made good by the Contractor at his expense upon demand of the Owner, it being required that all work will be in perfect condition when the period of warranty will have elapsed.”

“3.5.5 Upon notification by the Owner of a defect covered by the Contractor’s warranty, the Contractor shall respond within 4 hours of the notification.”

“3.5.6 In addition to the General Warranty there are other warranties required for certain items for different periods of time than the two years as above, and are particularly so stated in that part of the specifications referring to same. The said warranties will commence at the same time as the General Warranty.”

“3.5.7 If the Contractor fails to remedy any failure, defect or damage within a reasonable time after receipt of notice, the Owner will have the right to replace, repair, or otherwise remedy the failure, defect or damage at the Contractor’s expense.”

3.8 ALLOWANCES

Add the following Section:

“3.8.1.1 For costs to be covered under a project allowance, (included in the schedule of values) the Contractor shall submit a summary of those costs anticipated and an Allowance Access Authorization Form to the Architect and Owner, reflecting the projected costs. The Allowance Access Authorization Form must be signed by the Owner prior to initiating any work associated with the allowance.”

3.10 CONTRACTOR’S CONSTRUCTION AND SUBMITTAL SCHEDULES

3.10.1 Add “estimated” after “and the” and before “date of” in the second sentence.

3.10.2 Strike “and thereafter as necessary to maintain a current submittal schedule” in the first sentence.

3.11 DOCUMENTS AND SAMPLES AT THE SITE

Add the following Sections:

“3.11.1 During the course of the Work, the Contractor shall maintain a record set of drawings on which the Contractor shall mark the actual physical location of all piping, valves, equipment, conduit, outlets, access panels, controls, actuators, including all appurtenances that will be concealed once construction is complete, etc., including all invert elevations.”

“3.11.2 At the completion of the project, the Contractor shall obtain a set of the conformed contract drawings from the Architect, and neatly transfer all information outlined in 3.11.1 to provide a complete record of the as-built conditions.”

“3.11.3 Upon completion of the work noted in 3.11.2 the contractor shall schedule a meeting with the Architect/Engineer and Owner to review the final record drawings and closeout documents prior to submission. After this meeting the Contractor shall make adjustments per the review, and submit one (1) original markup and (2) copies of the red line drawings (as-built conditions, to the Owner and one (1) print to the Architect. In addition, attach one complete set of the as-built documents to each of the Operating and Maintenance Instructions/Manuals. The Contractor will include (2) USB drives, each containing all “red line drawings (as-built) and Closeout Documents properly tabbed in accordance with closeout requirements as defined elsewhere in the contract documents.”

3.12 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

3.12.10.2 Strike “If the Contract Documents require” from the beginning of the sentence.

3.12.10.2 Strike “to” between “professional” and certify” and replace with “shall”.

3.17 Insert “indemnify and” between “shall” and “hold” in the second sentence.

ARTICLE 4: ADMINISTRATION OF THE CONTRACT

4.2 ADMINISTRATION OF THE CONTRACT

4.2.7 Strike the first sentence and replace with the following:

“The Architect will review and approve or take other appropriate action upon the Contractor’s submittals such as Shop Drawings, Product Data and Samples for the purpose of checking for conformance with the Contract Documents.”

4.2.7 Strike the second sentence and replace with the following:

“The Architect’s action will be taken with such reasonable promptness as to cause no delay in the Work in the activities of the Owner, Contractor or separate Contractors, while allowing sufficient time in the Owner’s professional judgment to permit adequate review.”

Add the following Section:

“4.2.10.1 There will be no full-time Project Representative provided by the Owner or Architect on this project.”

“4.2.13 Add “and in compliance with all local requirements.” to the end of the sentence.”

ARTICLE 5: SUBCONTRACTORS

5.2 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK

5.2.3 Strike Section 5.2.3 in its entirety and replace with the following:

“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, subject to the statutory requirements of 29 Delaware Code § 6962(d)(10)b.3 and 4.”

5.2.4 Strike Section 5.2.4 in its entirety and replace with the following:

”The Contractor may not substitute any Subcontractor listed in its Bid unless the Contractor complies with the requirements of 29 Delaware Code § 6962(d)(10)b.3 and 4. Failure to comply with this requirement shall subject the Contractor to a penalty as outlined in Section 5.2 of the Owner’s General Requirements.”

Add the following Section:

“5.2.5 The Contractor shall comply and shall ensure all Subcontractors comply with all requirements for drug testing as set forth in TITLE 19 LABOR DELAWARE ADMINISTRATIVE CODE 4000 Office of Management and Budget 4100 Division of Facilities Management **4104 Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on Large Public Works Projects.**”

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 Strike “and waiver of subrogation” from the end of the second sentence.

6.1.4 Strike Section 6.1.4 in its entirety.

6.2 MUTUAL RESPONSIBILITY

6.2.3 Strike “shall” and replace with “may” in the second sentence.

ARTICLE 7: CHANGES IN THE WORK

(SEE ARTICLE 7: CHANGES IN WORK IN THE STATE OF DELAWARE DIVISION OF FACILITIES MANAGEMENT GENERAL REQUIREMENTS)

7.2 CHANGE ORDERS

Add the following Sections:

“7.2.2 In addition to the above:

7.2.2.1 The General Contractor is allowed a fifteen percent (15%) markup for overhead and profit for additional work performed by the General Contractor’s own forces.

7.2.2.2 For additional subcontractor work, the Subcontractor is allowed a fifteen (15) percent overhead and profit on change order work above and beyond the direct costs stated previously. To this amount, the General Contractor will be allowed a mark-up not exceeding seven- and one-half percent (7.5%) on the subcontractor’s work.

7.2.2.3 Where the Third Tier Contractor is going to be completing the additional work, the Third-Tier contractor will be allowed a markup of fifteen percent (15%) overhead and profit on changes order work above and beyond the direct costs stated previously. To this amount, the Subcontractor will be allowed a markup not to exceed seven and one-half percent (7.5%) on the Third-Tier Contractor’s work and the General Contractor will be allowed a markup not to exceed seven and one-half percent (7.5%) of the amount of the Subcontractor’s markup.

7.2.2.4 No additional costs shall be allowed for changes related to the Contractor’s onsite superintendent/staff, or project manager, unless a change in the work changes the project duration and is identified by the CPM schedule. There will be no other costs associated with the change order.

7.2.2.5 These markups shall include all costs including, but not limited to: overhead, profit, bonds, insurance, supervision, etc.”

7.3.4.1 Strike “and other employee costs approved by the Architect” after “worker’s compensation insurance,”

7.3.4.4 Add “work attributable to the” before “change” at the end of the sentence.

7.4 MINOR CHANGES IN THE WORK

Add “unless such changes are approved” at the end of the third sentence.

ARTICLE 8: TIME

8.2 PROGRESS AND COMPLETION

8.2.1 Add the following Section:

“8.2.1.1 Refer to Project Specifications Section SUMMARY OF WORK for Contract time requirements.”

8.2.2 After “by the Contractor” strike “and” and insert “to”.

8.2.4 Add the following Section:

“8.2.4 If the Work falls behind the Progress Schedule as submitted by the Contractor, the Contractor shall employ additional labor and/or equipment necessary to bring the Work into compliance with the Progress Schedule at no additional cost to the Owner.”

8.3 DELAYS AND EXTENSION OF TIME

8.3.1 Strike “binding dispute resolution” and insert “any and all remedies at law or in equity”.

Add the following Section:

“8.3.2.1 The Contractor shall update the status of the suspension, delay, or interruption of the Work with each Application for Payment. (The Contractor shall report the termination of such cause immediately upon the termination thereof.) Failure to comply with this procedure shall constitute a waiver for any claim for adjustment of time or price based upon said cause.”

Strike Section 8.3.3 in its entirety and replace with the following:

8.3.3 “Except in the case of a suspension of the Work directed by the Owner, an extension of time under the provisions of Section 8.3.1 shall be the Contractor’s sole remedy in the progress of the Work and there shall be no payment or compensation to the Contractor for any expense or damage resulting from the delay.”

Add the following Section:

“8.3.4 By permitting the Contractor to work after the expired time for completion of the project, the Owner does not waive their rights under the Contract.”

ARTICLE 9: PAYMENTS AND COMPLETION

9.2 SCHEDULE OF VALUES

Add the following Sections:

“9.2.1 The Schedule of Values shall be submitted using AIA Document G703, Continuation Sheet to G702.”

“9.2.2 The Schedule of Values is to include a line item for Project Closeout Document Submittal. The value of this item is to be no less than 1.5% of the initial contract amount.”

9.3 APPLICATIONS FOR PAYMENT

9.3.1 Strike Section 9.3.1 in its entirety and replace with the following:

“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 for completed portions of the Work. The application shall be notarized, and supported by all data substantiating the Contractor’s right to payment that the Owner or Architect require, such as copies of requisitions, and releases and waivers of liens from Subcontractors and suppliers, and shall reflect retainage.”

Add the following Sections:

“9.3.1.3 Application for Payment shall be submitted on AIA Document G702 “Application and Certificate for Payment”, supported by AIA Document G703 “Continuation Sheet”. Said Applications shall be fully executed and notarized.”

“9.3.4 Until Closeout Documents have been received and outstanding items completed the Owner will pay 95% (ninety-five percent) of the amount due the Contractor on account of progress payments.”

“9.3.5 The Contractor shall provide a current and updated Progress Schedule to the Architect with each Application for Payment. Failure to provide Schedule will be just cause for rejection of Application for Payment.”

9.5 DECISIONS TO WITHHOLD CERTIFICATION

Add the following Subsections to 9.5.1:

- .8 failure to provide a current Progress Schedule;
- .9 a lien or attachment is filed;
- .10 failure to comply with mandatory requirements for maintaining Record Documents.

9.6 PROGRESS PAYMENTS

9.6.1 Strike Section 9.6.1 in its entirety and replace with the following:

“9.6.1 After the Architect has approved and issued a Certificate for Payment, payment shall be made by the Owner within 30 days after Owner’s receipt of the Certificate for Payment.”

9.6.8 Strike “Provided the Owner has fulfilled its payment obligations under the Contract Documents,” in the first sentence.

9.7 FAILURE OF PAYMENT

Strike Section 9.7 in its entirety and replace with the following:

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

9.8 SUBSTANTIAL COMPLETION

9.8.3 At the end of Section 9.8.3, add the following sentence:

“If the Architect is required to make more than 2 inspections of the same portion of work, the Contractor shall be responsible for all costs associated with subsequent inspections including but not limited to any Architect’s fees.”

9.8.5 Strike “shall” and insert “may” in the second sentence.

9.8.5 Insert “1/2 of the” after “make payment of” in the second sentence.

9.9 PARTIAL OCCUPANCY OR USE

9.9.1 Strike the the first sentence and replace with the following (the remainder of the Section remains as written):

“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 authorized by public authorities having jurisdiction over the Project.”

9.10.2 Strike “to remain in force after final payment is currently in effect” after “required by the Contract Documents” and replace with “shall remain in force until final payment is completed” in the first sentence.

9.10.4.4 Strike “if permitted by the Contract Documents,”

ARTICLE 10: PROTECTION OF PERSONS AND PROPERTY

10.1 SAFETY PRECAUTIONS AND PROGRAMS

Add the following Sections:

10.1.1 Each Contractor shall develop a safety program in accordance with the Occupational Safety and Health Act of 1970. A copy of said plan shall be furnished to the Owner and Architect prior to the commencement of that Contractor’s Work.

10.1.2 Each Contractor shall appoint a Safety Representative. Safety Representatives shall be someone who is on site on a full time basis. If deemed necessary by the Owner or Architect, Contractor Safety meetings will be scheduled. The attendance of all Safety Representatives will be

required. Minutes will be recorded of said meetings by the Contractor and will be distributed to all parties as well as posted in all job offices/trailers etc.

10.2 SAFETY OF PERSONS AND PROPERTY

Add the following Section:

10.2.4.1 As required in the Hazardous Chemical Act of June 1984, all vendors supplying any material that may be defined as hazardous must provide Material Safety Data Sheets for those products. Any chemical product should be considered hazardous if it has a caution warning on the label relating to a potential physical or health hazard, if it is known to be present in the work place, and if employees may be exposed under normal conditions or in foreseeable emergency situations. Material Safety Data Sheets shall be provided directly to the Owner, along with the shipping slips that include those products.

10.2.5 Strike the second sentence in its entirety.

10.3 HAZARDOUS MATERIALS AND SUBSTANCES

10.3.3 Strike Section 10.3.3 in its entirety.

10.3.4 Insert "hazardous" in the last sentence after "handling of such" .

10.3.6 Strike Section 10.3.6 in its entirety.

ARTICLE 11: INSURANCE AND BONDS

11.1 CONTRACTOR'S INSURANCE AND BONDS

11.1.1 Strike "Owner" from the third sentence.

11.2 OWNER'S LIABILITY INSURANCE

Strike 11.2 in its entirety, except that in the case of school projects in which case Section 11.2 shall remain.

11.3 WAIVERS OF SUBROGATION

Delete Section 11.3 in its entirety

11.4 LOSS OF USE, BUSINESS INTERRUPTION, AND DELAY IN COMPLETION
INSURANCE

Delete Section 11.4 in its entirety

ARTICLE 12: UNCOVERING AND CORRECTION OF WORK

12.2.2 AFTER SUBSTANTIAL COMPLETION

Add the following Section:

- “12.2.2.1.1 At any time during the progress of the Work, or in any case where the nature of the defects will be such that it is not expedient to have corrected, the Owner, at its option, will have the right to deduct such sum, or sums, of money from the amount of the Contract as it considers justified to adjust the difference in value between the non-conforming work and that required under contract including any damage to the structure.”
- 12.2.2.1 Strike all references to “one year” or “one-year” and replace with “two years”.
- 12.2.2.2 Strike “one-year” and replace with “two years”.
- 12.2.2.3 Strike “one-year” and replace with “two years”.
- 12.2.5 Strike “one-year” and replaced with “two years”.

ARTICLE 13: MISCELLANEOUS PROVISIONS

13.1 GOVERNING LAW

Strike the last sentence.

13.4 TESTS AND INSPECTIONS

13.4.1 Strike the last sentence and replace with the following:

“The Owner shall pay for tests, inspections, or approvals where building codes or applicable laws or regulations prohibit the Owner from delegating their cost to the Contractor.”

13.5 INTEREST

Strike “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” and replace with “30 days of presentment of the authorized Certificate of Payment at the annual rate of 12% or 1% per month.”

Insert the following Section:

“13.6 CONFLICTS WITH FEDERAL STATUTES OR REGULATIONS

13.6.1 If any provision, specifications or requirement of the Contract Documents conflict or is inconsistent with any statute, law or regulation of the government of the United State of America, the Contractor shall notify the Architect and Owner immediately upon discovery.”

ARTICLE 14: TERMINATION OR SUSPENSION OF THE CONTRACT

14.1 TERMINATION BY THE CONTRACTOR

14.1.1.4 Insert “, upon the Contractors’ request,” after “furnish to the Contractor”.

14.1.3 Strike “and profit on Work not executed, and” after “as well as reasonable overhead” and replace with “, profit, and reasonable”

14.3 SUSPENSION BY OWNER FOR CONVENIENCE

14.3.2 Strike “Adjustment of the Contract Sum shall include profit”.

14.4 TERMINATION BY THE OWNER FOR CONVENIENCE

14.4.3 Strike Section 14.4.3 in its entirety and replace with the following:

“In case of such termination for the Owner’s convenience, the Contractor shall be entitled to receive payment for Work executed, and reasonable costs incurred by reason of such termination along with reasonable overhead.”

ARTICLE 15: CLAIMS AND DISPUTES

15.1 CLAIMS

15.1.2 TIME LIMITS ON CLAIMS

Strike the last sentence.

15.1.3 NOTICE OF CLAIM

Strike all references to “21” and replace with “45”.

15.1.5 CLAIMS FOR ADDITIONAL COSTS

Strike the first sentence and replace with the following:

“Contractor shall not proceed to execute any portion of the Work that is subject to the Claim without prior approval of the costs or method of payment for the costs associated with the Claim as determined by the Architect and approved by the Owner.”

15.1.7 WAIVER OF CLAIMS FOR CONSEQUENTIAL DAMAGES

Strike Section 15.1.7 in its entirety.

15.2 INITIAL DECISION

15.2.1 Strike “and binding dispute resolution” in the fourth sentence and replace with “or any and all remedies at law or in equity”.

15.2.5 Strike Section 15.2.5 in its entirety and replace with the following:

“The Architect will approve or reject Claims by written decision, which shall state the reasons therefore and shall notify the parties of any change in the Contract Sum or Contract Time or both. The approval or rejection of a Claim by the Architect shall be subject to mediation and any or all remedies at law or in equity.”

15.2.6 Strike Section 15.2.6 and its sub-Sections in their entirety.

15.3 MEDIATION

15.3.1 Strike “binding dispute resolution” and replace with “any or all remedies at law or in equity”.

15.3.2 Strike “, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedure in effect on the date of the Agreement,” in the first sentence.

- 15.3.2 Strike all references to “binding dispute resolution” and replace with “any or all remedies at law and in equity”.
- 15.3.3 Strike Section 15.3.3 in its entirety.
- 15.4 ARBITRATION

 Strike Section 15.4 and its Subsections in their entirety.

END OF SECTION

SECTION 00 73 43

DELAWARE DEPARTMENT OF LABOR PREVAILING WAGE RATES

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STATE OF DELAWARE
DEPARTMENT OF LABOR
DIVISION OF INDUSTRIAL AFFAIRS
OFFICE OF LABOR LAW ENFORCEMENT
PHONE: (302) 318-2769

Mailing Address:
252 Chapman Road
Suite 210
Newark, DE 19702

Located at:
252 Chapman Road
Suite 210
Newark, DE 19702

PREVAILING WAGES FOR BUILDING CONSTRUCTION EFFECTIVE MARCH 14, 2025

CLASSIFICATION	NEW CASTLE	KENT	SUSSEX
ASBESTOS WORKERS	29.89	36.79	53.56
BOILERMAKERS	89.46	45.39	66.72
BRICKLAYERS	66.79	66.79	66.79
CARPENTERS	62.56	62.56	50.80
CEMENT FINISHERS	94.36	67.11	52.04
ELECTRICAL LINE WORKERS	59.42	50.96	38.85
ELECTRICIANS	83.92	83.92	83.92
ELEVATOR CONSTRUCTORS	117.63	84.30	100.06
GLAZIERS	85.50	85.50	74.04
INSULATORS	69.12	69.12	69.12
IRON WORKERS	77.73	77.73	77.73
LABORERS	57.65	57.65	57.65
MILLWRIGHTS	88.35	88.35	70.97
PAINTERS	59.63	59.63	59.63
PILEDRIERS	91.12	51.44	41.60
PLASTERERS	39.01	39.01	28.91
PLUMBERS/PIPEFITTERS/STEAMFITTERS	79.55	82.95	73.71
POWER EQUIPMENT OPERATORS	83.29	83.29	83.29
ROOFERS-COMPOSITION	32.40	30.53	32.76
ROOFERS-SHINGLE/SLATE/TILE	24.03	28.59	22.47
SHEET METAL WORKERS	86.84	86.84	86.84
SOFT FLOOR LAYERS	61.68	61.68	47.74
SPRINKLER FITTERS	73.13	73.13	73.13
TERRAZZO/MARBLE/TILE FNRS	70.79	70.79	81.89
TERRAZZO/MARBLE/TILE STRS	78.73	78.73	90.82
TRUCK DRIVERS	56.88	35.86	27.91

CERTIFIED:

04/03/2025

BY:

[Signature]
ADMINISTRATOR, OFFICE OF LABOR LAW ENFORCEMENT

NOTE: THESE RATES ARE PROMULGATED AND ENFORCED PURSUANT TO THE PREVAILING WAGE REGULATIONS ADOPTED BY THE DEPARTMENT OF LABOR ON APRIL 3, 1992.

CLASSIFICATIONS OF WORKERS ARE DETERMINED BY THE DEPARTMENT OF LABOR. FOR ASSISTANCE IN CLASSIFYING WORKERS, OR FOR A COPY OF THE REGULATIONS, PHONE (302) 318-2769.

NON-REGISTERED APPRENTICES MUST BE PAID THE MECHANIC'S RATE.

PROJECT: Fort Miles Museum Addition, Sussex County



PREVAILING WAGE DEBARMENT LIST

The following contractors have been debarred for violations of the prevailing wage law 29Del.C. §6960 or other applicable State statutes.

Therefore, no public construction contract in this State shall be bid on, awarded to, or received by contractors and individuals on this list for a period of (3) three years from the date of the judgment or as deemed by a court of competent jurisdiction.

Contractor	Address	Date of Debarment
Mullen Brothers, Inc. and Daniel Mullen, individually	3375 Garnett Road, Boothwyn, PA 19060	Indefinite/ Civil Contempt
State Contractors Corporation, and Jose Oscar Rivera, individually	13004 Hathaway Drive Silver Spring, MD 20906	Indefinite/ 19 <u>Del.C.</u> 2374(f)
Green Granite and Jason Green, individually	604 Heatherbrooke Court Avondale, PA 19311	Indefinite/ Civil Contempt
Pro Image Landscaping, Inc. and Owner(s) individually	23 Commerce Street Wilmington, DE 19801 and/or 2 Cameo Road Claymont, DE 19703	Indefinite/19 <u>Del.C.</u> §108 & 10 <u>Del.C.</u> 542(c)
Liberty Mechanical, LLC and Owner(s), individually	2032 Duncan Road Wilmington, DE 19801	Indefinite/ 19 <u>Del.C.</u> 2374(f)
Integrated Mechanical and Fire Systems Inc. and Allison Sheldon, individually	4601 Governor Printz Boulevard Wilmington, DE 19809	Indefinite/19 <u>Del.C.</u> §108 & 10 <u>Del.C.</u> 542(c)
ACH 1, INC.	873 Salem Church Road Newark, DE 19702	Indefinite/19 <u>Del.C.</u> 6960

Updated: July 6, 2022

SECTION 00 81 13

GENERAL REQUIREMENTS

TABLE OF ARTICLES

1. GENERAL
2. OWNER
3. CONTRACTOR
4. ADMINISTRATION OF THE CONTRACT
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

ARTICLE 1: GENERAL

1.1 CONTRACT DOCUMENTS

1.1.1 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 to an extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the intended results.

1.1.2 Work including material purchases shall not begin until the Contractor is in receipt of a bonafide State of Delaware Purchase Order. Any work performed or material purchases prior to the issuance of the Purchase Order is done at the Contractor's own risk and cost.

1.2 EQUALITY OF EMPLOYMENT OPPORTUNITY ON PUBLIC WORKS

1.2.1 For Public Works Projects financed in whole or in part by state appropriation the Contractor agrees that during the performance of this contract:

1. The Contractor will not discriminate against any employee or applicant for employment because of race, creed, sex, color, sexual orientation, gender identity or national origin. The Contractor will take positive steps to ensure that applicants are employed and that employees are treated during employment without regard to their race, creed, sex, color, sexual orientation, gender identity or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places available to employees and applicants for employment notices to be provided by the contracting agency setting forth this nondiscrimination clause.
2. The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, creed, sex, color, sexual orientation, gender identity or national origin."

ARTICLE 2: OWNER

(NO ADDITIONAL GENERAL REQUIREMENTS – SEE SUPPLEMENTARY GENERAL CONDITIONS)

ARTICLE 3: CONTRACTOR

3.1 Schedule of Values: The successful Bidder shall within twenty (20) days after receiving notice to proceed with the work, furnish to the Owner a complete schedule of values on the various items comprising the work.

- 3.2 Subcontracts: Upon approval of Subcontractors, the Contractor shall award their Subcontracts as soon as possible after the signing of their own contract and see that all material, their own and those of their Subcontractors, are promptly ordered so that the work will not be delayed by failure of materials to arrive on time.
- 3.3 Before commencing any work or construction, the General Contractor is to consult with the Owner as to matters in connection with access to the site and the allocation of Ground Areas for the various features of hauling, storage, etc.
- 3.4 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.
- 3.5 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Contract. The Contractor shall not permit employment of unfit persons or persons not skilled in tasks assigned to them.
- 3.6 The Contractor warrants to the Owner that materials and equipment furnished will be new and of good quality, unless otherwise permitted, and that the work will be free from defects and in conformance with the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved, may be considered defective. If required by the Owner, the Contractor shall furnish evidence as to the kind and quality of materials and equipment provided.
- 3.7 Unless otherwise provided, the Contractor shall pay all sales, consumer, use and other similar taxes, and shall secure and pay for required permits, fees, licenses, and inspections necessary for proper execution of the Work.
- 3.8 The Contractor shall comply with and give notices required by laws, ordinances, rules, regulations, and lawful orders of public authorities bearing on performance of the Work. The Contractor shall promptly notify the Owner if the Drawings and Specifications are observed to be at variance therewith.
- 3.9 The Contractor shall be responsible to the Owner for the acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons performing portions of the Work under contract with the Contractor.
- 3.10 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 from and about the Project all waste materials, rubbish, the Contractor's tools, construction equipment, machinery and surplus materials. The Contractor shall be responsible for returning all damaged areas to their original conditions.
- 3.11 STATE LICENSE AND TAX REQUIREMENTS

- 3.11.1 Each Contractor and Subcontractor shall be licensed to do business in the State of Delaware and shall pay all fees and taxes due under State laws. In conformance with Section 2503, Chapter 25, Title 30, Delaware Code, "the Contractor shall furnish the Delaware Department of Finance within ten (10) days after entering into any contract with a contractor or subcontractor not a resident of this State, a statement of total value of such contract or contracts together with the names and addresses of the contracting parties."
- 3.12 The Contractor shall comply with all requirements set forth in Section 6962, Chapter 69, Title 29 of the Delaware Code.
- 3.13 During the contract Work, the Contractor and each Subcontractor, shall implement an Employee Drug Testing Program in accordance with OMB Regulation 4104 - "Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on "Large Public Works Projects". "Large Public Works" is based upon the current threshold required for bidding Public Works as set by the Purchasing and Contracting Advisory Council.

ARTICLE 4: ADMINISTRATION OF THE CONTRACT

4.1 CONTRACT SURETY

4.1.1 PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND

4.1.2 All bonds will be required as follows unless specifically waived elsewhere in the Bidding Documents.

4.1.3 Contents of Performance Bonds – The bond shall be in the form approved by the Office of Management and Budget. The bond shall be conditioned upon the faithful compliance and performance by the successful bidder of each and every term and condition of the contract and the proposal, plans, specifications, and bid documents thereof. Each term and condition shall be met at the time and in the manner prescribed by the Contract, Bid documents and the specifications, including the payment in full to every person furnishing materiel or performing labor in the performance of the Contract, of all sums of money due the person for such labor and materiel. (The bond shall also contain the successful bidder's guarantee to indemnify and save harmless the State and the agency from all costs, damages and expenses growing out of or by reason of the Contract in accordance with the Contract.)

4.1.4 Invoking a Performance Bond – The agency may, when it considers that the interest of the State so requires, cause judgement to be confessed upon the bond.

4.1.5 Within twenty (20) days after the date of notice of award of contract, the Bidder to whom the award is made shall furnish a Performance Bond and Labor and Material Payment Bond, each equal to the full amount of the Contract price to guarantee the faithful performance of all terms, covenants and conditions of the same. The bonds are to be issued by an acceptable Bonding Company licensed to do business in the State of Delaware and shall be issued in duplicate.

4.1.6 Performance and Payment Bonds shall be maintained in full force (warranty bond) for a period of two (2) years after the date of the Certificate for Final Payment. The Performance Bond shall guarantee the satisfactory completion of the Project and that the Contractor will make good any faults or defects in his work which may develop during the period of said guarantees as a result of improper or defective workmanship, material or apparatus, whether furnished by themselves or their Sub-Contractors. The Payment Bond shall guarantee that the Contractor shall pay in full all persons, firms or corporations who furnish labor or material or both labor and material for, or on account of, the work included herein. The bonds shall be paid for by this Contractor. The Owner shall have the right to demand that the proof parties signing the bonds are duly authorized to do so.

4.2 FAILURE TO COMPLY WITH CONTRACT

4.2.1 If any firm entering into a contract with the State, or Agency that neglects or refuses to perform or fails to comply with the terms thereof, the Agency which signed the Contract may terminate the Contract and proceed to award a new contract in accordance with this Chapter 69, Title 29 of the Delaware Code or may require the Surety on the Performance Bond to complete the Contract in accordance with the terms of the Performance Bond. Nothing herein shall preclude the Agency from pursuing additional remedies as otherwise provided by law.

4.3 CONTRACT INSURANCE AND CONTRACT LIABILITY

4.3.1 In addition to the bond requirements stated in the Bid Documents, each successful Bidder shall purchase adequate insurance for the performance of the Contract and, by submission of a Bid, agrees to indemnify and save harmless and to defend all legal or equitable actions brought against the State, any Agency, officer and/or employee of the State, for and from all claims of liability which is or may be the result of the successful Bidder's actions during the performance of the Contract.

4.3.2 The purchase or nonpurchase of such insurance or the involvement of the successful Bidder in any legal or equitable defense of any action brought against the successful Bidder based upon work performed pursuant to the Contract will not waive any defense which the State, its agencies and their respective officers, employees and agents might otherwise have against such claims, specifically including the defense of sovereign immunity, where applicable, and by the terms of this section, the State and all agencies, officers and employees thereof shall not be financially responsible for the consequences of work performed, pursuant to said contract.

4.4 RIGHT TO AUDIT RECORDS

4.4.1 The Owner shall have the right to audit the books and records of a Contractor or any Subcontractor under any Contract or Subcontract to the extent that the books and records relate to the performance of the Contract or Subcontract.

- 4.4.2 Said books and records shall be maintained by the Contractor for a period of seven (7) years from the date of final payment under the Prime Contract and by the Subcontractor for a period of seven (7) years from the date of final payment under the Subcontract.

ARTICLE 5: SUBCONTRACTORS

5.1 SUBCONTRACTING REQUIREMENTS

- 5.1.1 All contracts for the construction, reconstruction, alteration or repair of any public building (not a road, street or highway) shall be subject to the following provisions:
1. A contract shall be awarded only to a Bidder whose Bid is accompanied by a statement containing, for each Subcontractor category, the name and address (city or town and State only – street number and P.O. Box addresses not required) of the subcontractor whose services the Bidder intends to use in performing the Work and providing the material for such Subcontractor category.
 2. A Bid will not be accepted nor will an award of any Contract be made to any Bidder which, as the Prime Contractor, has listed itself as the Subcontractor for any Subcontractor unless:
 - A. It has been established to the satisfaction of the awarding Agency that the Bidder has customarily performed the specialty work of such Subcontractor category by artisans regularly employed by the Bidder's firm;
 - B. That the Bidder is duly licensed by the State to engage in such specialty work, if the State requires licenses; and
 - C. That the Bidder is recognized in the industry as a bona fide Subcontractor or Contractor in such specialty work and Subcontractor category.
- 5.1.2 The decision of the awarding Agency as to whether a Bidder who list itself as the Subcontractor for a Subcontractor category shall be final and binding upon all Bidders, and no action of any nature shall lie against any awarding agency or its employees or officers because of its decision in this regard.
- 5.1.3 After such a Contract has been awarded, the successful Bidder shall not substitute another Subcontractor for any Subcontractor whose name was set forth in the statement which accompanied the Bid without the written consent of the awarding Agency.
- 5.1.4 No Agency shall consent to any substitution of Subcontractors unless the Agency is satisfied that the Subcontractor whose name is on the Bidders accompanying statement:
- A. Is unqualified to perform the work required;
 - B. Has failed to execute a timely reasonable Subcontract;

- C. Has defaulted in the performance on the portion of the work covered by the Subcontract; or
- D. Is no longer engaged in such business.

5.1.5 Should a Bidder be awarded a contract, such successful Bidder shall provide to the agency the taxpayer identification license numbers of such subcontractors. Such numbers shall be provided on the later of the date on which such subcontractor is required to be identified or the time the contract is executed. The successful Bidder shall provide to the agency to which it is contracting, within 30 days of entering into such public works contract, copies of all Delaware Business licenses of subcontractors and/or independent contractors that will perform work for such public works contract. However, if a subcontractor or independent contractor is hired or contracted more than 20 days after the Bidder entered the public works contract the Delaware Business license of such subcontractor or independent contractor shall be provided to the agency within 10 days of being contracted or hired.

5.1.6 The Contractor may employ additional Subcontractors on the jobsite only after submitting a copy of the Subcontractor's Employee Drug Testing Program to the Owner for approval. A Contractor or Subcontractor shall not commence work until the Owner has concluded its review and determined that the submitted Employee Drug Testing Program complies with OMB Regulation 4104.

5.2 PENALTY FOR SUBSTITUTION OF SUBCONTRACTORS

5.2.1 Should the Contractor fail to utilize any or all of the Subcontractors in the Contractor's Bid statement in the performance of the Work on the public bidding, the Contractor shall be penalized in the amount of (project specific amount*). The Agency may determine to deduct payments of the penalty from the Contractor or have the amount paid directly to the Agency. Any penalty amount assessed against the Contractor may be remitted or refunded, in whole or in part, by the Agency awarding the Contract, only if it is established to the satisfaction of the Agency that the Subcontractor in question has defaulted or is no longer engaged in such business. No claim for the remission or refund of any penalty shall be granted unless an application is filed within one year after the liability of the successful Bidder accrues. All penalty amounts assessed and not refunded or remitted to the contractor shall be reverted to the State.

*one (1) percent of contract amount not to exceed \$10,000

5.3 ASBESTOS ABATEMENT

5.3.1 The selection of any Contractor to perform asbestos abatement for State-funded projects shall be approved by the Office of Management and Budget, Division of Facilities Management pursuant to Chapter 78 of Title 16.

5.4 STANDARDS OF CONSTRUCTION FOR THE PROTECTION OF THE PHYSICALLY HANDICAPPED

5.4.1 All Contracts shall conform with the standard established by the Delaware Architectural Accessibility Board unless otherwise exempted by the Board.

5.5 CONTRACT PERFORMANCE

5.5.1 Any firm entering into a Public Works Contract that neglects or refuses to perform or fails to comply with its terms, the Agency may terminate the Contract and proceed to award a new Contract or may require the Surety on the Performance Bond to complete the Contract in accordance with the terms of the Performance Bond.

ARTICLE 6: CONSTRUCTION BY OWNER OR SEPARATE CONTRACTORS

6.1 The Owner reserves the right to simultaneously perform other 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 Projects at the same site.

6.2 The Contractor shall afford the Owner and other Contractors reasonable opportunity for access and storage of materials and equipment, and for the performance of their activities, and shall connect and coordinate their activities with other forces as required by the Contract Documents.

ARTICLE 7: CHANGES IN THE WORK

7.1 The Owner, without invalidating the Contract, may order changes in the Work consisting of Additions, Deletions, Modifications or Substitutions, with the Contract Sum and Contract completion date being adjusted accordingly. Such changes in the Work shall be authorized by written Change Order signed by the Professional, as the duly authorized agent, the Contractor and the Owner.

7.2 The Contract Sum and Contract Completion Date shall be adjusted only by a fully executed Change Order.

7.3 The additional cost, or credit to the Owner resulting from a change in the Work shall be by mutual agreement of the Owner, Contractor and the Architect. In all cases, this cost or credit shall be based on the 'DPE' wages required and the "invoice price" of the materials/equipment needed.

7.3.1 "DPE" shall be defined to mean "direct personnel expense". Direct payroll expense includes prevailing wage rates plus a maximum multiplier of 1.35 times DPE. For example, if the prevailing wage rate is \$50/hour, the DPE would be \$67.50/hour (50 x 1.35).

7.3.2 "Invoice price" of materials/equipment shall be defined to mean the actual cost of materials and/or equipment that is paid by the Contractor, (or subcontractor), to a material distributor, direct factory vendor, store, material provider, or equipment leasing entity. Rates for equipment that is leased and/or owned by the Contractor or subcontractor(s) shall not exceed those listed in the latest version of the "Means Building Construction Cost Data" publication.

- 7.3.3 In addition to the above:
- 7.3.3.1 The General Contractor is allowed a fifteen percent (15%) markup for overhead and profit for additional work performed by the General Contractor's own forces.
- 7.3.3.2 For additional subcontractor work, the Subcontractor is allowed a fifteen (15) percent overhead and profit on change order work above and beyond the direct costs stated previously. To this amount, the General Contractor will be allowed a mark-up not exceeding seven- and one-half percent (7.5%) on the subcontractor's work.
- 7.3.3.3 Where the Third Tier Contractor is going to be completing the additional work, the Third-Tier contractor will be allowed a markup of fifteen percent (15%) overhead and profit on changes order work above and beyond the direct costs stated previously. To this amount, the Subcontractor will be allowed a markup not to exceed seven and one-half percent (7.5%) on the Third-Tier Contractor's work and the General Contractor will be allowed a markup not to exceed seven and one-half percent (7.5%) of the amount of the Subcontractor's markup.
- 7.3.3.4 No additional costs shall be allowed for changes related to the Contractor's onsite superintendent/staff, or project manager, unless a change in the work changes the project duration and is identified by the CPM schedule. There will be no other costs associated with the change order.
- 7.3.3.5 These markups shall include all costs including, but not limited to: overhead, profit, bonds, insurance, supervision, etc.

ARTICLE 8: TIME

- 8.1 Time limits, if any, are as stated in the Project Manual. By executing the Agreement, the Contractor confirms that the stipulated limits are reasonable, and that the Work will be completed within the anticipated time frame.
- 8.2 If progress of the Work is delayed at any time by changes ordered by the Owner, by labor disputes, fire, unusual delay in deliveries, abnormal adverse weather conditions, unavoidable casualties or other causes beyond the Contractor's control, the Contract Time shall be extended for such reasonable time as the Owner may determine.
- 8.3 Any extension of time beyond the date fixed for completion of the construction and acceptance of any part of the Work called for by the Contract, or the occupancy of the building by the Owner, in whole or in part, previous to the completion shall not be deemed a waiver by the Owner of his right to annul or terminate the Contract for abandonment or delay in the matter provided for, nor relieve the Contractor of full responsibility
- 8.4 **SUSPENSION AND DEBARMENT**
- 8.4.1 Per Section 6962(d)(14), Title 29, Delaware Code, "Any Contractor who fails to perform a public works contract or complete a public works project within the time schedule

established by the Agency in the Invitation To Bid, may be subject to Suspension or Debarment for one or more of the following reasons: a) failure to supply the adequate labor supply ratio for the project; b) inadequate financial resources; or, c) poor performance on the Project.”

- 8.4.2 “Upon such failure for any of the above stated reasons, the Agency that contracted for the public works project may petition the Director of the Office of Management and Budget for Suspension or Debarment of the Contractor. The Agency shall send a copy of the petition to the Contractor within three (3) working days of filing with the Director. If the Director concludes that the petition has merit, the Director shall schedule and hold a hearing to determine whether to suspend the Contractor, debar the Contractor or deny the petition. The Agency shall have the burden of proving, by a preponderance of the evidence, that the Contractor failed to perform or complete the public works project within the time schedule established by the Agency and failed to do so for one or more of the following reasons: a) failure to supply the adequate labor supply ratio for the project; b) inadequate financial resources; or, c) poor performance on the project. Upon a finding in favor of the Agency, the Director may suspend a Contractor from Bidding on any project funded, in whole or in part, with public funds for up to 1 year for a first offense, up to 3 years for a second offense and permanently debar the Contractor for a third offense. The Director shall issue a written decision and shall send a copy to the Contractor and the Agency. Such decision may be appealed to the Superior Court within thirty (30) days for a review on the record.”

8.5 RETAINAGE

- 8.5.1 Per Section 6962(d)(5) a.3, Title 29, Delaware Code: The Agency may at the beginning of each public works project establish a time schedule for the completion of the project. If the project is delayed beyond the completion date due to the Contractor’s failure to meet their responsibilities, the Agency may forfeit, at its discretion, all or part of the Contractor’s retainage.
- 8.5.2 This forfeiture of retainage also applies to the timely completion of the punchlist. A punchlist will only be prepared upon the mutual agreement of the Owner, Architect and Contractor. Once the punchlist is prepared, all three parties will by mutual agreement, establish a schedule for its completion. Should completion of the punchlist be delayed beyond the established date due to the Contractor’s failure to meet their responsibilities, the Agency may hold permanently, at its discretion, all or part of the Contractor’s retainage.

ARTICLE 9: PAYMENTS AND COMPLETION

9.1 APPLICATION FOR PAYMENT

- 9.1.1 Applications for payment shall be made upon AIA Document G702. There will be a five percent (5%) retainage on all Contractor's monthly invoices until completion of the project. This retainage may become payable upon receipt of all required closeout documentation, provided all other requirements of the Contract Documents have been met.

- 9.1.2 A date will be fixed for the taking of the monthly account of work done. Upon receipt of Contractor's itemized application for payment, such application will be audited, modified, if found necessary, and approved for the amount. Statement shall be submitted to the Owner.
- 9.1.3 Section 6516, Title 29 of the Delaware Code annualized interest is not to exceed 12% per annum beginning thirty (30) days after the "presentment" (as opposed to the date) of the invoice.
- 9.2 PARTIAL PAYMENTS
- 9.2.1 Any public works Contract executed by any Agency may provide for partial payments at the option of the Owner with respect to materials placed along or upon the sites or stored at secured locations, which are suitable for use in the performance of the contract.
- 9.2.2 When approved by the agency, partial payment may include the values of tested and acceptable materials of a nonperishable or noncontaminative nature which have been produced or furnished for incorporation as a permanent part of the work yet to be completed, provided acceptable provisions have been made for storage.
- 9.2.2.1 Any allowance made for materials on hand will not exceed the delivered cost of the materials as verified by invoices furnished by the Contractor, nor will it exceed the contract bid price for the material complete in place.
- 9.2.3 If requested by the Agency, receipted bills from all Contractors, Subcontractors, and material, men, etc., for the previous payment must accompany each application for payment. Following such a request, no payment will be made until these receipted bills have been received by the Owner.
- 9.3 SUBSTANTIAL COMPLETION
- 9.3.1 When the building has been made suitable for occupancy, but still requires small items of miscellaneous work, the Owner will determine the date when the project has been substantially completed.
- 9.3.2 If, after the Work has been substantially completed, full completion thereof is materially delayed through no fault of the Contractor, and without terminating the Contract, the Owner may make payment of the balance due for the portion of the Work fully completed and accepted. Such payment shall be made under the terms and conditions governing final payment that it shall not constitute a waiver of claims.
- 9.3.3 On projects where commissioning is included, the commissioning work as defined in the specifications must be complete prior to the issuance of substantial completion.
- 9.4 FINAL PAYMENT
- 9.4.1 Final payment, including the five percent (5%) retainage if determined appropriate, shall be made within thirty (30) days after the Work is fully completed and the Contract fully performed and provided that the Contractor has submitted the following closeout

documentation (in addition to any other documentation required elsewhere in the Contract Documents):

- 9.4.1.1 Evidence satisfactory to the Owner that all payrolls, material bills, and other indebtedness connected with the work have been paid,
- 9.4.1.2 An acceptable RELEASE OF LIENS,
- 9.4.1.3 Copies of all applicable warranties,
- 9.4.1.4 As-built drawings,
- 9.4.1.5 Operations and Maintenance Manuals,
- 9.4.1.6 Instruction Manuals,
- 9.4.1.7 Consent of Surety to final payment.
- 9.4.1.8 The Owner reserves the right to retain payments, or parts thereof, for its protection until the foregoing conditions have been complied with, defective work corrected and all unsatisfactory conditions remedied.

ARTICLE 10: PROTECTION OF PERSONS AND PROPERTY

- 10.1 The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract. The Contractor shall take all reasonable precautions to prevent damage, injury or loss to: workers, persons nearby who may be affected, the Work, materials and equipment to be incorporated, and existing property at the site or adjacent thereto. The Contractor shall give notices and comply with applicable laws ordinances, rules regulations, and lawful orders of public authorities bearing on the safety of persons and property and their protection from injury, damage, or loss. The Contractor shall promptly remedy damage and loss to property at the site caused in whole or in part by the Contractor, a Subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable.
- 10.2 The Contractor shall notify the Owner in the event any existing hazardous material such as lead, PCBs, asbestos, etc. is encountered on the project. The Owner will arrange with a qualified specialist for the identification, testing, removal, handling and protection against exposure or environmental pollution, to comply with applicable regulation laws and ordinances. The Contractor and Architect will not be required to participate in or to perform this operation. Upon completion of this work, the Owner will notify the Contractor and Architect in writing the area has been cleared and approved by the authorities in order for the work to proceed. The Contractor shall attach documentation from the authorities of said approval.
- 10.3 As required in the Hazardous Chemical Information Act of June 1984, all vendors supplying any materials that may be defined as hazardous, must provide Material Safety Data Sheets for those products. Any chemical product should be considered hazardous if it has a

warning caution on the label relating to a potential physical or health hazard, if it is known to be present in the work place, and if employees may be exposed under normal conditions or in any foreseeable emergency situation. Material Safety Data Sheets must be provided directly to the Owner along with the shipping slips that include those products.

- 10.4 The Contractor shall certify to the Owner that materials incorporated into the Work are free of all asbestos. This certification may be in the form of Material Safety Data Sheet (MSDS) provided by the product manufacturer for the materials used in construction, as specified or as provided by the Contractor.

ARTICLE 11: INSURANCE AND BONDS

- 11.1 The Contractor shall carry all insurance required by law, such as Unemployment Insurance, etc. The Contractor shall carry such insurance coverage as they desire on their own property such as a field office, storage sheds or other structures erected upon the project site that belong to them and for their own use. The Subcontractors involved with this project shall carry whatever insurance protection they consider necessary to cover the loss of any of their personal property, etc.
- 11.2 Upon being awarded the Contract, the Contractor shall obtain a minimum of two (2) copies of all required insurance certificates called for herein, and submit one (1) copy of each certificate, to the Owner, within 20 days of contract award.
- 11.3 Bodily Injury Liability and Property Damage Liability Insurance shall, in addition to the coverage included herein, include coverage for injury to or destruction of any property arising out of the collapse of or structural injury to any building or structure due to demolition work and evidence of these coverages shall be filed with and approved by the Owner.
- 11.4 The Contractor's Property Damage Liability Insurance shall, in addition to the coverage noted herein, include coverage on all real and personal property in their care, custody and control damaged in any way by the Contractor or their Subcontractors during the entire construction period on this project.
- 11.5 Builders Risk (including Standard Extended Coverage Insurance) on the existing building during the entire construction period, may be provided by the Contractor under this contract. The Owner shall insure the existing building and all of its contents and all this new alteration work under this contract during entire construction period for the full insurable value of the entire work at the site. Note, however, that the Contractor and their Subcontractors shall be responsible for insuring building materials (installed and stored) and their tools and equipment whenever in use on the project, against fire damage, theft, vandalism, etc.
- 11.6 Certificates of the insurance company or companies stating the amount and type of coverage, terms of policies, etc., shall be furnished to the Owner, within 20 days of contract award.
- 11.7 The Contractor shall, at their own expense, (in addition to the above) carry the following forms of insurance:

11.7.1 Contractor's Contractual Liability Insurance

Minimum coverage to be:

Bodily Injury	\$1,000,000 \$3,000,000	for each occurrence aggregate
Property Damage	\$1,000,000 \$3,000,000	for each occurrence aggregate

11.7.2 Contractor's Protective Liability Insurance

Minimum coverage to be:

Bodily Injury	\$1,000,000 \$3,000,000	for each occurrence aggregate
Property Damage	\$1,000,000 \$3,000,000	for each occurrence aggregate

11.7.3 Automobile Liability Insurance

Minimum coverage to be:

Bodily Injury	\$1,000,000 \$1,000,000	for each person for each occurrence
Property Damage	\$500,000	per accident

11.7.4 Prime Contractor's and Subcontractors' policies shall include contingent and contractual liability coverage in the same minimum amounts as 11.7.1 above.

11.7.5 Workmen's Compensation (including Employer's Liability):

11.7.5.1 Minimum Limit on employer's liability to be as required by law.

11.7.5.2 Minimum Limit for all employees working at one site.

11.7.6 Certificates of Insurance must be filed with the Owner guaranteeing fifteen (15) days prior notice of cancellation, non-renewal, or any change in coverages and limits of liability shown as included on certificates.

11.7.7 Social Security Liability

11.7.7.1 With respect to all persons at any time employed by or on the payroll of the Contractor or performing any work for or on their behalf, or in connection with or arising out of the

Contractor's business, the Contractor shall accept full and exclusive liability for the payment of any and all contributions or taxes or unemployment insurance, or old age retirement benefits, pensions or annuities now or hereafter imposed by the Government of the United States and the State or political subdivision thereof, whether the same be measured by wages, salaries or other remuneration paid to such persons or otherwise.

11.7.7.2 Upon request, the Contractor shall furnish Owner such information on payrolls or employment records as may be necessary to enable it to fully comply with the law imposing the aforesaid contributions or taxes.

11.7.7.3 If the Owner is required by law to and does pay any and/or all of the aforesaid contributions or taxes, the Contractor shall forthwith reimburse the Owner for the entire amount so paid by the Owner.

ARTICLE 12: UNCOVERING AND CORRECTION OF WORK

12.1 The Contractor shall promptly correct Work rejected by the Owner or failing to conform to the requirements of the Contract Documents, whether observed before or after Substantial Completion and whether or not fabricated, installed or completed, and shall correct any Work found to be not in accordance with the requirements of the Contract Documents within a period of two years from the date of Substantial Completion, or by terms of an applicable special warranty required by the Contract Documents. The provisions of this Article apply to work done by Subcontractors as well as to Work done by direct employees of the Contractor.

12.2 At any time during the progress of the work, or in any case where the nature of the defects shall be such that it is not expedient to have them corrected, the Owner, at their option, shall have the right to deduct such sum, or sums, of money from the amount of the contract as they consider justified to adjust the difference in value between the defective work and that required under contract including any damage to the structure.

ARTICLE 13: MISCELLANEOUS PROVISIONS

13.1 CUTTING AND PATCHING

13.1.1 The Contractor shall be responsible for all cutting and patching. The Contractor shall coordinate the work of the various trades involved.

13.2 DIMENSIONS

13.2.1 All dimensions shown shall be verified by the Contractor by actual measurements at the project site. Any discrepancies between the drawings and specifications and the existing conditions shall be referred to the Owner for adjustment before any work affected thereby has been performed.

13.3 LABORATORY TESTS

- 13.3.1 Any specified laboratory tests of material and finished articles to be incorporated in the work shall be made by bureaus, laboratories or agencies approved by the Owner and reports of such tests shall be submitted to the Owner. The cost of the testing shall be paid for by the Contractor.
- 13.3.2 The Contractor shall furnish all sample materials required for these tests and shall deliver same without charge to the testing laboratory or other designated agency when and where directed by the Owner.
- 13.4 **ARCHAEOLOGICAL EVIDENCE**
- 13.4.1 Whenever, in the course of construction, any archaeological evidence is encountered on the surface or below the surface of the ground, the Contractor shall notify the authorities of the State Historic Preservation Office and suspend work in the immediate area for a reasonable time to permit those authorities, or persons designated by them, to examine the area and ensure the proper removal of the archaeological evidence for suitable preservation by the Division of Historical and Cultural Affairs.
- 13.5 **GLASS REPLACEMENT AND CLEANING**
- 13.5.1 The General Contractor shall replace without expense to the Owner all glass broken during the construction of the project. If job conditions warrant, at completion of the job the General Contractor shall have all glass cleaned and polished.
- 13.6 **WARRANTY**
- 13.6.1 For a period of two (2) years from the date of substantial completion, as evidenced by the date of final acceptance of the work, the contractor warrants that work performed under this contract conforms to the contract requirements and is free of any defect of equipment, material or workmanship performed by the contractor or any of his subcontractors or suppliers. However, manufacturer's warranties and guarantees, if for a period longer than two (2) years, shall take precedence over the above warranties. The contractor shall remedy, at his own expense, any such failure to conform or any such defect. The protection of this warranty shall be included in the Contractor's Performance Bond.

ARTICLE 14: TERMINATION OR SUSPENSION OF THE CONTRACT

- 14.1 If the Contractor defaults or persistently fails or neglects to carry out the Work in accordance with the Contract Documents or fails to perform a provision of the Contract, the Owner, after seven days written notice to the Contractor, may make good such deficiencies and may deduct the cost thereof from the payment then or thereafter due the Contractor. Alternatively, at the Owner's option, and the Owner may terminate the Contract and take possession of the site and of all materials, equipment, tools, and machinery thereon owned by the Contractor and may finish the Work by whatever method the Owner may deem expedient. If the costs of finishing the Work exceed any unpaid compensation due the Contractor, the Contractor shall pay the difference to the Owner.

- 14.2 “If the continuation of this Agreement is contingent upon the appropriation of adequate state, or federal funds, this Agreement may be terminated on the date beginning on the first fiscal year for which funds are not appropriated or at the exhaustion of the appropriation. The Owner may terminate this Agreement by providing written notice to the parties of such non-appropriation. All payment obligations of the Owner will cease upon the date of termination. Notwithstanding the foregoing, the Owner agrees that it will use its best efforts to obtain approval of necessary funds to continue the Agreement by taking appropriate action to request adequate funds to continue the Agreement.”

END OF SECTION

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EMPLOYEE DRUG TESTING REPORT FORM

Period Ending: _____

4104 Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on Large Public Works Projects requires that Contractors and Subcontractors who work on Large Public Works Contracts funded all or in part with public funds maintain testing data that includes but is not limited to the data elements below.

Project Number: _____

Project Name: _____

Contractor/Subcontractor Name: _____

Contractor/Subcontractor Address: _____

Number of employees who worked on the jobsite during the report period: _____

Number of employees subject to random testing during the report period: _____

Number of Negative Results _____ Number of Positive Results _____

Action taken on employee(s) in response to a failed or positive random test:

Date: _____

This form is not required to be submitted to the Owner. Included as a reference to show information required to be maintained by the Contractor. The Owner shall have the right to periodically audit all Contractor and Subcontractor test results at the Contractor's or Subcontractor's offices (or by other means to make the data available for inspection by the Owner).

**EMPLOYEE DRUG TESTING
REPORT OF POSITIVE RESULTS**

4104 Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on Large Public Works Projects requires that Contractors and Subcontractors who work on Large Public Works Contracts funded all or in part with public funds to notify the Owner in writing of a positive random drug test.

Project Number: _____

Project Name: _____

Contractor/Subcontractor Name: _____

Contractor/Subcontractor Address: _____

Name of employee with positive test result: _____

Last 4 digits of employee SSN: _____

Date test results received: _____

Action taken on employee in response to a positive test result:

Authorized Representative of Contractor/Subcontractor: _____
(typed or printed)

Authorized Representative of Contractor/Subcontractor: _____
(signature)

Date: _____

This form shall be sent by mail to the Owner within 24 hours of receipt of test results.

Enclose this test results form in a sealed envelope with the notation "Drug Testing Form – DO NOT OPEN" on the face thereof and place in a separate mailing envelope.

SECTION 00 81 14

DRUG TESTING FORMS

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ADDITION TO BATTERY 519

Cape Henlopen State Park
15099 Cape Henlopen Drive
Lewes, DE 19958
NAT25814-FTMILESGC

**AFFIDAVIT OF
CRAFT TRAINING COMPLIANCE**

We, the contractor, hereby certify that we and all applicable subcontractors will abide by the contractor and subcontractor craft training requirements outlined below for the duration of the contract. Craft training must be provided by a contractor and/or subcontractor for each craft on a project for which there are Delaware Department of Labor approved and registered training programs or, if the contractor and/or subcontractor meets the requirements under Title 29, Chapter 69, Section 6960A.(b)(1)c.1.-3., payment may be made in accordance with Title 29, Chapter 69, Section 6960A.(b)(1)d. A list of crafts for which there are approved and registered training programs is maintained by the Delaware Department of Labor and can be found at:

<https://laborfiles.delaware.gov/main/det/apprenticeship/DE%20Craft%20Training%20Occupation%20List%20Effective%20March%201%202022.pdf>. If you have questions regarding craft training programs, please submit all questions in writing to the Delaware Department of Labor at: apprenticeship@delaware.gov. ***This Affidavit of Craft Training Compliance must be submitted prior to contract execution.***

In accordance with Title 29, Chapter 69, Section 6960A.(a)(1), a contract relating to a public works project under § 6962 of Title 29 must include a craft training program for each craft in the project if at the time the contractor executes a public works contract, all of the following apply:

- a. A project meets the prevailing wage requirement under Section 6960 of Title 29.
- b. The contractor employs 10 or more total employees.
- c. The project is not a federal highway project, except for the project under Section 6962(c)(11) of Title 29.
- d. There is an apprenticeship program for a craft in the project on the list of crafts under Section 204(b)(2) of Title 19.

Pursuant to Title 29, Chapter 69, Section 6960A.(a)(2), ***a contractor must commit that all subcontractors provide craft training*** if paragraph (a)(1) of this section applies to the subcontractor. Failure to provide required craft training or payment on the project may subject the successful contractor and/or subcontractor(s) to penalties as outlined in Title 29, Chapter 69, Section 6960A.(d)(1)-(3).

Craft(s):

Contractor Name:

Contractor Address:

Contractor Program

Registration Number(s) _____

On this line also indicate whether DE, Other State (identify) or US Registration Number

Or

☐ A payment has been made in the amount established under Section 204(b)(2)b.2. of Title 19, for the craft into the Delaware Department of Labor's Apprenticeship and Training Fund.

Or

☐ Craft Training requirements are not applicable because:

Authorized Representative (typed or printed): _____

Authorized Representative (signature): _____

Title: _____

State of Delaware)
County of _____) ss:

Before me, a notary public, in and for said county and state, personally appeared, _____, who acknowledged to me that she/he did execute the foregoing instrument on behalf of _____.

IN TESTIMONY WHEREOF, I have subscribed my name and affixed my official seal this ____ day of _____ 20__.

Notary Public
Commission Expires _____

THIS PAGE MUST BE SIGNED AND NOTARIZED TO BE CONSIDERED.

SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Work under separate contract.
4. Allowances.
5. Unit Prices.
6. Applications for Payment.
7. Owner Supplied Construction Documents.
8. Coordination.
9. Phased construction.
10. Access to site.
11. Coordination with occupants.
12. Work restrictions.
13. Specification and drawing conventions.
14. Field Engineering.
15. References and Standards.
16. Miscellaneous provisions.

- B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

- A. Project Identification: Addition to Battery 519.

1. Project Location: 15099 Cape Henlopen Drive, Lewes, DE 19958

- B. Owner: State of Delaware, Division of Natural Resources and Environmental Control, Parks and Recreation, 89 Kings Highway, Dover DE 19901.

- C. Architect/Engineer's Identification: The Contract Documents, dated April 30, 2025, were prepared for this Project by GWWO Inc. 1215 East Fort Avenue, Suite 24, Baltimore, MD 21230.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following:
 - 1. Building addition to the museum, housed inside Battery 519, providing a lobby, restrooms, and an office. Site utility work to bring power, water and sanitary to the addition. Site improvements include landscaping, concrete and paving. Work within Battery 519 includes changes to doors, providing new walls and doors, and fire alarm installation throughout.
- B. Type of Contract:
 - 1. Project will be constructed under a single, lump sum prime contract.

1.5 WORK UNDER SEPARATE CONTRACTS

- A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under separate contracts as it will have an impact on the General Contractor's scope of work. The General Contractor shall allow the separate contractors access to scaffolding and/or high reaches.
 - 1. Exhibit installation work in the addition to be completed by others.
 - 2. Items noted "NIC" (Not in Contract) will be furnished and installed by others.

1.6 ALLOWANCES

- A. Schedule of Allowances: Refer to Section 012100 Allowances.

1.7 UNIT PRICES

- A. Unit Prices quoted on the Bid form will be exercised as Owner option.
- B. Coordinate related work and modify surrounding work affected by accepted unit prices as required to complete the Work.
- C. Schedule of Unit Prices: Refer to Section 012200 Unit Prices.

1.8 APPLICATIONS FOR PAYMENT

- A. Submit three (3) originals of each application under procedures of Section 012900 Payment Procedures.
- B. Content and Format: Use the Project Manual table of contents to develop the Schedule of Values.

1.9 OWNER SUPPLIED CONSTRUCTION DOCUMENTS

- A. The Contractor will be furnished, free of charge one electronic PDF file drawings and Project Manuals that are conformed to include all drawings and specification revised during the bid process. Paper sets will be furnished at the cost of reproduction, postage and handling.

1.10 COORDINATION

- A. Coordinate Work of the various sections of Specifications to assure efficient and orderly sequence of installation of construction elements, with provisions for accommodating items installed later.
- B. Verify characteristics of elements of interrelated operating equipment are compatible; coordinate Work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- C. Coordinate space requirements and installation of mechanical, electrical and plumbing work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduits, as closely as practicable; make runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- D. In finished areas (except as otherwise shown), conceal pipes, ducts, and wiring in the construction. Coordinate locations of fixtures and outlets with finish elements.
- E. Execute cutting and patching to integrate elements of Work, uncover ill-timed defective and non-conforming work, provide openings for penetrations of existing surfaces, and provide samples for testing. Seal penetrations through floors, walls, and ceilings.

1.11 ACCESS TO SITE

- A. General: Contractor shall have partial use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- B. Use of Site: Limit use of Project site to areas within the Contract limits. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Limits: Confine construction operations to the areas as indicated. The building and the surrounding site are currently occupied and the Owner's operations shall not be disturbed unless scheduled in advance.
 2. Driveways, Walkways and Entrances: Keep public roads, public parking, driveways and entrances outside of the work area serving premises clear and available to Owner, Owner's employees, emergency vehicles and general public at all times. Do not use these areas for parking or storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
 3. The adjacent building areas, site and properties are occupied and shall not be disturbed.
 4. The Contractor will only be permitted to access Battery 519 through the north entrance. The Contractor will not be permitted to access Battery 519 through the middle, south, or overlook entrance to Battery 519.
 5. From Dune Road, Contractor access to the site will only be permitted from the south access road. The Contractor will not have access to the road throughout the Cantonment Area, or the public pathways from the Cantonment Road up the hill to the north entrance to Battery 519. Contractor access from the parking lot to Battery 519 is limited to the Construction Entrance as noted on the drawings.
- C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weather tight condition throughout construction period. Repair damage caused by construction operations.

1.12 COORDINATION WITH OCCUPANTS

- A. Full Owner Occupancy: Owner will occupy site and Battery 519 during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.
1. Maintain access to existing walkways, entrances, corridors, stairs and other adjacent occupied or used facilities. Do not close or obstruct walkways, entrances, stairs, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction. Entrances shall be open for the Owner's use at all times.
 2. Barricade work areas to keep the public from entering.
 3. Notify Owner not less than one week in advance of activities that will affect Owner's operations.
 4. Owner will coordinate with the Contractor for specific special events during the year.
 5. The building and site should remain open during typical open hours on Fridays, Saturdays, and Sundays.

1.13 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
 - 2. Refer to Section 011400 "Work Restrictions" for additional requirements.
- B. On-Site Work Hours: Limit work to the site and/or existing building to normal business working hours of 7:00 a.m. to 5:00 p.m., Monday through Friday, unless otherwise indicated.
 - 1. Weekend Hours: Weekend work shall not be allowed unless preapproved by the Owner.
 - 2. Early Morning Hours: Early morning hours are not allowed unless required for utility shut downs.
- C. Noise, Vibration, and Odors: Coordinate operations that may result in any level of noise and vibration, odors, or other disruption to the occupancy or use of adjacent occupied areas, the buildings and adjacent properties with the Owner.
 - 1. Notify Architect and Owner not less than seven (7) days in advance of proposed disruptive operations.
 - 2. Obtain Architect's and/or Owner's written permission before proceeding with disruptive operations.
- D. Nonsmoking Campus and Building: Smoking is prohibited within the boundaries of all state workplaces including all buildings, facilities, indoor and outdoor spaces and all the surrounding grounds owned by the State. This policy also includes but is not limited to parking lots, walkways, State vehicles and private vehicles parked or operated on State workplace property.
- E. Existing Utility Interruptions: Do not interrupt utilities serving the facility occupied by the Owner unless permitted under the following conditions and then only after arranging to provide temporary utility services according to the requirements indicated:
 - 1. Notify the Owner not less than 7 days in advance of the proposed utility interruption.
 - 2. Do not proceed with utility interruptions without approval by the Owner.
 - 3. Hours for Utility Shutdowns: As approved by the Owner and limited to no more than eight (8) hours at a time.

1.14 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 - 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
 - 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 - 2. Abbreviations: Materials and products are identified by abbreviations 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.

1.15 FIELD ENGINEERING

- A. Provide field engineering services; establish grades, lines, and levels, by use of recognized engineering survey practices.
- B. Control datum for survey is that shown on drawings. Locate and protect control and reference points.

1.16 REFERENCES AND STANDARDS

- A. For products specified by association or trade standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. The date of the standard is that in effect as of the Bid date, except when a specific date is specified.
- C. Obtain copies of standards when required by Contract Documents. Maintain copy at job site during progress of the specific work.

1.17 MISCELLANEOUS PROVISIONS

A. SCHEDULE

- 1. The following is the required schedule for this work:
 - a. Bids Due: **Date and Time**
 - b. Notice of Building Contract Award: Within thirty (30) days of receipt and acceptance of qualified low bid.
 - c. Purchase Order Issuance: The issuance of a State of Delaware purchase order is contingent upon the successful Contractor submitting bonds on State-approved forms, signed contracts and insurance certificates to the State of Delaware within

20 days of Notice of Award. A purchase order will be issued in approximately thirty days after these items have been submitted to the State of Delaware.

- d. On-Site Mobilization: Upon receipt of State of Delaware purchase order.
 - e. Substantial Completion: It is the State of Delaware's preference that the work shall be completed 10 months from on-site start of work.
 - f. Completion of Punch List: 21 days from date of substantial completion.
- 1) Refer to the General Requirements for additional details.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 00

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SECTION 01 14 00 - WORK RESTRICTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 USE OF PREMISES

- A. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of site beyond areas in which the Work is indicated.
 - 1. Limits: Confine construction operations to the limits indicated on the drawings. Do not disturb areas to remain occupied during the renovations.
 - 2. Owner Occupancy: The building (Battery 519) and the surrounding site is currently occupied and will be occupied during the renovation and construction process. The surrounding occupied areas, site, buildings, roadways, access into the buildings, etc. beyond the work area shall remain accessible to the Owner.
 - 3. Parking: Contractor parking will be limited to the location shown on the site plan.
 - 4. Dumpster: Dumpster location is shown on the site plan. The dumpster shall be covered to avoid windblown debris. Debris shall be removed on a regular basis in order to avoid an overflowing dumpster. Restoration of grounds disturbed by the dumpster will be required upon completion of the Project. "No Trespassing" signs shall be placed on the dumpster.
 - 5. Access: Contractor access to Battery 519 restricted to north entrance only. Access to Battery 519 from middle, south, or the overlook entrance is not permitted. From Dune Road, contractor access to the site only permitted from the south access road. Contractor access not permitted through the Cantonment Area.
 - 6. Storage: Contractor is not allowed to store material within Battery 519.
 - 7. Public Roadways, Driveways, Entrances and Public Sidewalks: Keep public roadways, driveways, entrances and public sidewalks serving premises clear and available to the Public, 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 use of roadways, driveways, sidewalks and entrances.
 - b. The Owner will not sign for any deliveries at any time.
 - c. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
 - 8. Contractor and subcontractor promotional signage will not be allowed at the project site or within the Park unless approved by the Owner.
- B. Use of Existing Building: Maintain the existing building in a weathertight condition throughout renovation period. Repair damage caused by construction operations. Protect building and its contents during construction period.

1. The Contractor shall be provided full access to Battery 519 and partial access to the surrounding site as necessary to complete the work. Keys shall be provided to the Contractor.
2. Use of the Owner's telephones will not be allowed.
3. Flammable materials shall not be stored in Battery 519. Flammable materials shall be kept outside, away from all buildings, in a flammable liquid/material storage box.
4. Gas powered equipment will not be allowed in the buildings or near windows and intake louvers at any time.
5. Debris shall be removed from and around Battery 519 including the sidewalks, trails and parking areas on a daily basis.
6. At no times shall equipment be left operating in and around Battery 519 after hours or when no one is present in the building.
7. Noisy activities shall take place during the hours defined by Sussex County and Cape Henlopen State Park and prescheduled with the Owner to avoid disruption of their activities.
8. Access to water will not be provided.
9. There will be no restroom facilities (either within Battery 519 or throughout the site) available during Addition to Battery 519. The Contractor shall provide a self-contained toilet unit securely attached to the ground and kept locked after hours.
10. Advance notice and approval by the Owner required for utility interruptions.
11. Advance notice and approval required by the Owner for work that may be disruptive to the building use.
12. Dogs or other animals shall not be brought onto the property at any time.
13. Children shall not be brought onto the site at any time.
14. The general surrounds of Battery 519 are open to the public and those working at the site shall not use abusive language.
15. Radios or other music-playing devices will not be allowed. Headphones and ear buds will not be allowed.
16. Fire extinguishers shall be kept in the areas under renovation at Battery 519 and in new construction at all times.
17. All work taking place on the site shall be monitored by the contractor's project superintendent at all times even if the General Contractor's work forces are not working at the site.
18. The Project superintendent shall discuss weekly with the DNREC Project Manager to review the activities planned for that week to avoid miscommunication, facilitate the renovation process and to maintain the Owner's operations.
19. Walk off mats shall be provided at entrances to all construction areas from public ways.
20. Provide protective barriers and covers at entrances and public access areas where work is taking place overhead.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 14 00

SECTION 01 21 00 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements governing allowances.
- B. Selected materials and equipment are specified in the Contract Documents by Allowances. In some cases, these Allowances include installation. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation. If necessary, additional requirements will be issued by Proposal Request.
- C. Types of allowances include the following:
 - 1. Lump-sum allowances.
 - 2. Unit-cost Allowances.
 - 3. Contingency Allowances.
- D. Related Requirements:
 - 1. Section 012200 "Unit Prices" for procedures for using unit prices.

1.3 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise Owner of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.
- B. At Owner's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected in writing by Owner from the designated supplier.

1.4 ACTION SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.

1.5 INFORMATIONAL SUBMITTALS

- A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.
- C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.6 COORDINATION

- A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.7 LUMP-SUM ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.
- C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
 - 1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.8 ADJUSTMENT OF ALLOWANCES

- A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
 - 1. Include installation costs in purchase amount only where indicated as part of the allowance.
 - 2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
 - 3. Submit substantiation of a change in scope of work, if any, claimed in Change Orders related to unit-cost allowances.

4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.
 - B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.
 1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of work has changed from what could have been foreseen from information in the Contract Documents.
 2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.
- 1.9 Contingency Allowances:
- A. Use the Contingency Allowance only as directed for the Owner's purposes and only by Change Orders that indicate amounts to be charged to the Allowance.
 - B. Change Orders authorizing use of funds from the Contingency Allowance, for purchase of products and equipment, will include Contractor's related costs and reasonable overhead and profit margins. These related costs include delivery, installation, taxes, insurance, equipment rental, and similar costs.
 - C. At Project Closeout, credit unused amounts remaining in the Contingency Allowance to the Owner by Change Order.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

A. Allowance No. 1 - Lump-Sum Allowance: Include the sum of \$30,000 for unforeseen issues.

1. This allowance includes material cost, receiving, handling, installation and Contractor overhead and profit.

END OF SECTION 01 21 00

SECTION 01 22 00 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for unit prices.
- B. Related Sections include the following:
 - 1. Division 1 Section "Contract Modification Procedures" for procedures for submitting and handling Change Orders.

1.3 DEFINITIONS

- A. Unit price is an amount proposed by bidders, stated on the Bid Form, as a price per unit of measurement for materials or services added to or deducted from the Contract Sum by appropriate modification, if estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
- B. Measurement and Payment: Refer to individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
- C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
- D. List of Unit Prices: A list of unit prices is included at the end of this Section. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 LIST OF UNIT PRICES

A. Unit Price No. 1 – Repair of Exterior Concrete.

1. Description: Provide all labor and material to repair existing exterior or interior concrete, where authorized or directed.
2. Unit of Measurement: Square feet.

B. Unit Price No. 2 – Demolition of Exterior Concrete

1. Description: Provide all labor and material to remove existing exterior concrete, where authorized or directed.
2. Unit of Measurement: Cubic feet.

END OF SECTION 01 22 00

SECTION 01 24 00 - PERMITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes permits that have been issued for this Project as well as permits-in-progress initiated by the Owner and those required Contractor application.

1.3 DEFINITIONS

- A. Permits: A document issued by the Authorities having jurisdiction approving specific construction. Permits may approve the documents as submitted or contain caveats that are to be followed.
 - 1. Preconstruction Permits: Permits issued prior to the bidding and award, and which are required prior to proceeding to this stage.
 - 2. Post Bid Permits: Permits required to be applied for by the successful contractor. These include demolition permits, building permits and sub-permits such as mechanical, electrical, fire suppression and plumbing.
 - 3. Post Construction Permits: Permits issued by the authorities having jurisdiction stating that a structure or portion of the structure has been approved as complying with applicable laws, regulations and codes and may be occupied and put to its intended use.

1.4 RESPONSIBILITIES

- A. The Contractor shall abide by the approved permits which are to include the notations provided by the entity/person approving the permit.
- B. The Contractor is responsible for obtaining and paying for all construction permits unless stated otherwise in the construction documents.
 - 1. The Contractor shall conform to all of the regulations and requirements, and shall be responsible for costs associated therewith, of all permits required of the Work.
 - 2. The Contractor shall be responsible for scheduling all inspections as required by the permits.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ISSUED PERMITS

- A. Department of Natural Resources and Environmental Control (DNREC).
 - 1. Sediment and Stormwater Plan Approval.
- B. State of Delaware Architectural Accessibility Board (AAB)
- C. State of Delaware Fire Marshal

3.2 SCHEDULE OF PENDING PERMITS TO BE APPLIED FOR BY THE CONTRACTOR

- A. Sussex County Building Permit

END OF SECTION 01 24 00

SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Sections include the following:
 - 1. Division 1 Section "Submittal Procedures for" administrative procedures for handling requests for substitutions made after Contract award.

1.3 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. 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 time specified in Proposal Request after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include 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.
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 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.
 5. Comply with requirements in Division 1 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.

1.5 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 26 00

SECTION 01 29 00 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Sections include the following:
 - 1. Division 1 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 2. Division 1 Section "Construction Progress Documentation" for administrative requirements governing preparation and submittal of 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. Correlate 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.
 - 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 the 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 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.
 - 1) Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate.
4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
5. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. Include evidence of insurance or bonded warehousing if required.
6. 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.
7. 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.
8. 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 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. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets 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 of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

- E. Transmittal: Submit 3 signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. 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.
- F. 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. List of Contractor's staff assignments (Project Superintendent specifically).
 - 5. Copies of building permits.
 - 6. Certificates of insurance and insurance policies.
 - 7. Performance and payment bonds.
- G. Application for Payment at Substantial Completion: After issuing 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.
- H. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
 - 1. Updated final statement, accounting for final changes to the Contract Sum.
 - 2. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
 - 3. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
 - 4. AIA Document G707, "Consent of Surety to Final Payment."

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 29 00

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SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General project coordination procedures.
 - 2. Administrative and supervisory personnel.
 - 3. Project meetings.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 1 Section "Construction Progress Documentation" for preparing and submitting the Contractor's Construction Schedule.
 - 2. Division 1 Section "Closeout Procedures" for coordinating Contract closeout.

1.3 COORDINATION

- A. Coordination: Coordinate construction operations included in various 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 with subcontractors to ensure maximum accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. If necessary, 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 if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's Construction Schedule.
2. Preparation of the Schedule of Values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.

1.4 SUBMITTALS

- A. Staff Names: Within 15 days of notice to proceed, submit a list of principal staff 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 and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.

1.5 PROJECT MEETINGS

- A. General: The Architect will 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.
 2. Minutes: The Architect will record significant discussions and agreements achieved. The minutes will be distributed to everyone concerned, including Owner, within 7 days of the meeting.
- B. Preconstruction Conference: A preconstruction conference will be scheduled before the start of construction, at a time convenient to the Owner and Contractor, but no later than 15 days after execution of the Agreement. The conference will be held at the Project. The meeting will be conducted to review responsibilities and personnel assignments.
 1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Items of significance that could affect progress will be discussed, including the following:
 - a. Tentative construction schedule.
 - b. Designation of responsible personnel.
 - c. Procedures for processing field decisions and Change Orders.
 - d. Procedures for processing Applications for Payment.
 - e. Submittal procedures.
 - f. Preparation of Record Documents.
 - g. Use of the premises.
 - h. Responsibility for temporary facilities and controls.
 - i. Parking availability.

- j. Storage areas.
 - k. Equipment deliveries and priorities.
 - l. Progress cleaning.
 - m. Working hours.
- C. Progress Meetings: Progress meetings will be conducted every two weeks. Coordinate dates of meetings with preparation of payment requests.
- 1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 2. 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.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Deliveries.
 - 2) Off-site fabrication.
 - 3) Access.
 - 4) Site utilization.
 - 5) Temporary facilities and controls.
 - 6) Work hours.
 - 7) Progress cleaning.
 - 8) Quality and work standards.
 - 9) Existing Utility Interruptions
 - 10) Work that is anticipated to disrupt building use.
 - 3. Reporting: The Architect will distribute minutes of the meeting to each party present and to parties who should have been present. A brief summary, in narrative form, of progress since the previous meeting and report will be included.
 - a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. The revised schedule will be issued concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 00

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SECTION 01 31 50 – FIELD ENGINEERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative provisions and procedural requirements for Field Engineering services, including, but not necessarily limited to the following:
 - 1. Land Survey Work.
 - 2. Engineering services.

1.3 SUBMITTALS

- A. Certificates: Submit a certificate signed by the Land Surveyor certifying that the location and elevation of improvements comply with the Contract Documents.
- B. Project Record Documents: Submit a record of Work performed and record survey data as required under provisions of Sections "Submittals" and "Project Closeout".

1.4 QUALITY ASSURANCE

- A. Surveyor: Engage a Professional Land Surveyor, licensed in the State of Delaware, to perform required surveying services to ensure that grades, lines, levels, and locations of the Work are in compliance with the Contract Documents.
- B. Engineer: Engage a Professional Engineer of the discipline required, registered in the State of Delaware, to perform required engineering services.

1.5 EXAMINATION

- A. The Owner will identify existing control points and property line corner stakes.
- B. Verify layout information shown on the Drawings, in relation to the property survey and existing benchmarks before proceeding to layout the Work. Locate and protect existing benchmarks and control points. Preserve permanent reference points during construction.
 - 1. Do not change or relocate benchmarks or control points without prior written approval. Promptly report lost or destroyed reference points, or requirements to relocate reference points because of necessary changes in grades or locations.
 - 2. Promptly replace lost or destroyed Project control points. Base replacements on the original survey control points.

- C. Establish and maintain a minimum of two permanent benchmarks on the site, referenced to data established by survey control points.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
- D. Existing utilities and equipment: 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.

1.6 PERFORMANCE

- A. Working from lines and levels established by the property survey, establish benchmarks and markers to set lines and levels at each story of construction and elsewhere as needed to properly locate each element of the Project. Calculate and measure required dimensions within indicated or recognized tolerances. Do not scale Drawings to determine dimensions.
 - 1. Advise entities engaged in construction activities, of marked lines and levels provided for their use.
 - 2. As construction proceeds, check every major element for line, level and plumb.
- B. Surveyor's Log: Maintain a surveyor's log of control and other survey Work. Make this log available for reference.
 - 1. Record deviations from required lines and levels, and advise the Architect when deviations that exceed indicated or recognized tolerances are detected. On Project Record Drawings, record deviations that are accepted and not corrected.
 - 2. 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.
- C. Site Improvements: Locate and lay out site improvements, including pavements, stakes for grading, fill and topsoil placement, utility slopes and invert elevations by instrumentation and similar appropriate means.
- D. Building Lines and Levels: Locate and lay out batter boards for structures, building foundations, column grids and locations, floor levels and control lines and levels required for mechanical and electrical work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 50

SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Contractor's Construction Schedule.
 - 2. Field condition reports.
 - 3. Special reports.
- B. Related Sections include the following:
 - 1. Division 1 Section "Payment Procedures" for submitting the Schedule of Values.
 - 2. Division 1 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes.

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 activities are activities on the critical path. They must start and finish on the planned early start and finish times.
- 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. Major Area: A story of construction, a separate building, or a similar significant construction element.
- F. Milestone: A key or critical point in time for reference or measurement.

1.4 SUBMITTALS

- A. Preliminary Construction Schedule: Submit two opaque copies.
- B. Contractor's Construction Schedule: Submit two opaque copies of initial schedule, large enough to show entire schedule for entire construction period.
- C. Field Condition Reports: Submit two copies at time of discovery of differing conditions.
- D. Special Reports: Submit two copies at time of unusual event.

1.5 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, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from parties 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. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."
- B. Time Frame: Extend schedule from date established for commencement of the Work to date of Substantial Completion.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each separate area as a separate numbered activity for each principal 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. Submittal Review Time: Include review and resubmittal times indicated in Division 1 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.

3. 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.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
 1. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Use of premises restrictions.
 - c. Provisions for future construction.
 - d. Seasonal variations.
 - e. Environmental control.
 2. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Mockups.
 - b. Fabrication.
 - c. Deliveries.
 - d. Installation.
- E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.
- F. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragnets to demonstrate the effect of the proposed change on the overall project schedule.

2.2 CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: Submit horizontal bar-chart-type construction schedule within five days of date established for commencement of the Work.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities.

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.
7. Accidents.
8. Meetings and significant decisions.
9. Unusual events (refer to special reports).
10. Stoppages, delays, shortages, and losses.
11. Emergency procedures.
12. Orders and requests of authorities having jurisdiction.
13. Change Orders received and implemented.
14. Construction Change Directives received and implemented.
15. Substantial Completions authorized.

- B. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a request for interpretation. 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 one day 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 bi-weekly intervals, update schedule to reflect actual construction progress and activities. Issue schedule at each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. As the Work progresses, indicate Actual Completion percentage for each activity.
- B. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, and other parties identified by Contractor with a need-to-know schedule responsibility.

END OF SECTION 01 32 00

SECTION 01 32 33 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for the following:
 - 1. Preconstruction photographs.
 - 2. Periodic construction photographs.
 - 3. Final Completion construction photographs.
- B. Related Sections include the following:
 - 1. Division 01 Section "Submittal Procedures" for submitting photographic documentation.
 - 2. Division 01 Section "Closeout Procedures" for submitting digital media as Project Record Documents at Project closeout.
 - 3. Division 01 Section "Selective Demolition" for photographic documentation before selective demolition operations commence.

1.3 SUBMITTALS

- A. Construction Digital Images: Submit a complete set of digital image electronic files as part of the Project closeout on CD-ROM, DVD or flash drive. Identify electronic media with date photographs were taken. Submit images that have same aspect ratio as the sensor, uncropped.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

- A. Digital Images: Provide images in uncompressed TIFF or JPEG format, produced by a digital camera with minimum sensor size of 12.0 megapixels, and at an image resolution of not less than 4000 by 3000 pixels.

PART 3 - EXECUTION

3.1 CONSTRUCTION PHOTOGRAPHS

- A. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.
 - 1. Photographs are to be taken weekly at a minimum during normal construction and daily during small duration projects or significant activities.
 - 2. Photographs are to be taken prior to the start of the work to record existing conditions.
 - 3. Photographs are to be taken when areas are opened prior to the start of the new work.
 - 4. Photographs are to be taken during demolition operations.

5. Provide temporary lighting when required to produce clear, well-lit photographs without obscuring shadows.
- B. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
 1. Date and Time: Include date and time in filename for each image.
 2. Field Office Images: Maintain one set of images on CD-ROM in the field office at Project site, available at all times for reference. Identify images same as for those submitted to Architect.
- C. Preconstruction Photographs: Before commencement of excavation and/or demolition, and starting of construction take color, digital photographs of Project building interior and exterior, site and surrounding properties, including existing items to remain during construction, from different vantage points, or as directed by Architect.
 1. Flag excavation areas and construction limits before taking construction photographs.
 2. Take a minimum of eight photographs to show existing conditions adjacent to building before starting the Work.
 3. Take a minimum of eight photographs of existing buildings adjacent to the building to accurately record physical conditions at start of construction.
 4. Take a minimum of four photographs of each existing room even if renovations are not planned in that space.
 5. Take as many photographs as necessary to document the exterior of the existing building.
 6. Take additional photographs as required to record settlement or cracking of adjacent pavements, and other improvements.
- D. Architect-Directed Construction Photographs: From time to time, Architect will instruct the Contractor about number and frequency of color, digital photographs and general directions on vantage points. Select actual vantage points and take photographs to show the status of construction and progress since last photographs were taken.
- E. Final Completion Construction Photographs: Take a minimum of four-color photographs of each room and eight color photographs of the exterior after date of Substantial Completion for submission as Project Record Documents. Architect will direct photographer for desired vantage points.
 1. Do not include date stamp.

END OF SECTION 01 32 33

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Sections include the following:
 - 1. Division 1 Section "Payment Procedures" for submitting Applications for Payment and the Schedule of Values.
 - 2. Division 1 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes and for submitting Coordination Drawings.
 - 3. Division 1 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule and the Submittals Schedule.
 - 4. Division 1 Section "Quality Requirements" for submitting test and inspection reports and for mockup requirements.
 - 5. Division 1 Section "Closeout Procedures" for submitting warranties.
 - 6. Division 1 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 7. Division 1 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.

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. General: Electronic copies of select CAD Drawing files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals. The Contractor will be responsible for field verifying existing conditions.

- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow 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 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow 15 days for review of each resubmittal.
 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
- 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 6 by 8 inches (150 by 200 mm) 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 Architect.
 - d. Name and address of Contractor.
 - e. Name and address of subcontractor.
 - f. Name and address of supplier.
 - g. Name of manufacturer.
 - h. Submittal number or other unique identifier, including revision identifier.
 - 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 06100.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 06100.01.A).
 - i. Number and title of appropriate Specification Section.
 - j. Drawing number and detail references, as appropriate.

- k. Location(s) where product is to be installed, as appropriate.
 - l. Other necessary identification.
- E. Deviations: Highlight 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. Submit one electronic copy of submittal to concurrent reviewer.
- 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: Provide locations on form for the following information:
 - a. Project name.
 - b. Date.
 - c. Destination (To:).
 - d. Source (From:).
 - e. Names of subcontractor, manufacturer, and supplier.
 - f. Category and type of submittal.
 - g. Submittal purpose and description.
 - h. Specification Section number and title.
 - i. Drawing number and detail references, as appropriate.
 - j. Submittal and transmittal distribution record.
 - k. Remarks.
 - l. Signature of transmitter.
 - 2. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same label information as related submittal.
- 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 "Furnish as Submitted".
- I. 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.

- J. Use for Construction: Use only final submittals with mark indicating "Furnish as Submitted" or "Revise as Noted & Furnish" taken by Architect.

1.5 CONTRACTOR'S USE OF ARCHITECT'S CAD FILES

- A. General: At Contractor's written request, copies of Architect's CAD files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:
 - 1. CADD files are limited to those that have been generated for this Project.
 - 2. CADD files for the floor plans and roof plans shall be provided. Files for details, etc. will not be provided.
 - 3. Contractor will be asked to sign Architects waiver of release form before files will be delivered to the contractor.

PART 2 - PRODUCTS

2.1 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. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
 - 2. Mark each copy of each submittal to show which products and options are applicable.
 - 3. Include the following information, as applicable:
 - a. Manufacturer's written recommendations.
 - b. Manufacturer's product specifications.
 - c. Manufacturer's installation instructions.
 - d. Standard color charts.
 - e. Manufacturer's catalog cuts.
 - f. Wiring diagrams showing factory-installed wiring.
 - g. Printed performance curves.
 - h. Operational range diagrams.
 - i. Mill reports.
 - j. Standard product operation and maintenance manuals.
 - k. Compliance with specified referenced standards.
 - l. Testing by recognized testing agency.
 - m. Application of testing agency labels and seals.
 - n. Notation of coordination requirements.
 - 4. Submit Product Data before or concurrent with Samples.

5. Submit electronic files of Product Data, unless otherwise indicated. Architect will return the reviewed files. Retain 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.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Dimensions.
 - b. Identification of products.
 - c. Fabrication and installation drawings.
 - d. Roughing-in and setting diagrams.
 - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
 - f. Shopwork manufacturing instructions.
 - g. Templates and patterns.
 - h. Schedules.
 - i. Design calculations.
 - j. Compliance with specified standards.
 - k. Notation of coordination requirements.
 - l. Notation of dimensions established by field measurement.
 - m. Relationship to adjoining construction clearly indicated.
 - n. Seal and signature of professional engineer if specified.
 - o. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm) but no larger than 24 by 36 inches.
 3. Number of Copies: Submit electronic files of each submittal. Retain copies where copies are required for operation and maintenance manuals. The Architect will return the reviewed files.
- 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.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
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 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.
5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit four sets of Samples. Architect will retain three Sample sets; remainder will be returned.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least four sets of paired units that show approximate limits of variations.
- E. Product Schedule or List: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
 1. Type of product. Include unique identifier for each product.
 2. Number and name of room or space.
 3. Location within room or space.
 4. Number of Copies: Submit three copies of product schedule or list, unless otherwise indicated. Architect will return two copies.
 - a. Mark up and retain one returned copy as a Project Record Document.

- F. Contractor's Construction Schedule: Comply with requirements specified in Division 1 Section "Construction Progress Documentation" for Construction Manager's action.
- G. Submittals Schedule: Comply with requirements specified in Division 1 Section "Construction Progress Documentation."
- H. Application for Payment: Comply with requirements specified in Division 1 Section "Payment Procedures."
- I. Schedule of Values: Comply with requirements specified in Division 1 Section "Payment Procedures."
- J. 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.
 - 4. Number of Copies: Submit three copies of subcontractor list, unless otherwise indicated. Architect will return two copies.
 - a. Mark up and retain one returned copy as a Project Record Document.

2.2 INFORMATIONAL SUBMITTALS

- A. General: Prepare and submit Informational Submittals required by other Specification Sections.
 - 1. Number of Copies: Submit electronic files. Architect will not return copies.
 - 2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - 3. Test and Inspection Reports: Comply with requirements specified in Division 1 Section "Quality Requirements."
- B. Coordination Drawings: Comply with requirements specified in Division 1 Section "Project Management and Coordination."
- C. Contractor's Construction Schedule: Comply with requirements specified in Division 1 Section "Construction Progress Documentation."
- D. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

- E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
- F. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- G. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- H. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- I. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- J. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- K. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- L. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - 1. Name of evaluation organization.
 - 2. Date of evaluation.
 - 3. Time period when report is in effect.
 - 4. Product and manufacturers' names.
 - 5. Description of product.
 - 6. Test procedures and results.
 - 7. Limitations of use.
- M. Schedule of Tests and Inspections: Comply with requirements specified in Division 1 Section "Quality Requirements."
- N. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- O. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed

before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

- P. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- Q. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 1 Section "Operation and Maintenance Data."
- R. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.
- S. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:
 - 1. Preparation of substrates.
 - 2. Required substrate tolerances.
 - 3. Sequence of installation or erection.
 - 4. Required installation tolerances.
 - 5. Required adjustments.
 - 6. Recommendations for cleaning and protection.
- T. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
 - 1. Name, address, and telephone number of factory-authorized service representative making report.
 - 2. Statement on condition of substrates and their acceptability for installation of product.
 - 3. Statement that products at Project site comply with requirements.
 - 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 - 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 - 6. Statement whether conditions, products, and installation will affect warranty.
 - 7. Other required items indicated in individual Specification Sections.
- U. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.

- V. Material Safety Data Sheets (MSDSs): Submit information directly to Owner; do not submit to Architect.
 - 1. Architect will not review submittals that include MSDSs and will return the entire submittal for resubmittal.

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.

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, as follows:
 - 1. Furnish as Submitted.
 - 2. Revise as Noted & Furnish.
 - 3. Revise as Noted & Furnish. Submit Revised Copy for Record.
 - 4. Revise & Resubmit.
- 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 33 00

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 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. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 3. 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. Related Sections include but are not limited to the following:
 - 1. Division 1 Section "Construction Progress Documentation" for developing a schedule of required tests and inspections.
 - 2. Division 1 Section "Cutting and Patching" for repair and restoration of construction disturbed by testing and inspecting activities.

1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and

completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.

- C. Mockups: Full-size, physical assemblies that are constructed on-site. Mockups are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Approved mockups establish the standard by which the Work will be judged.
- D. Laboratory Mockups: Full-size, physical assemblies that are constructed at testing facility to verify performance characteristics.
- E. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.
- F. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.
- G. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.
- H. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- I. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- J. 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 trades people of the corresponding generic name.
- K. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 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.

1.5 SUBMITTALS

- A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- B. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Description of test and inspection.
 - 3. Identification of applicable standards.
 - 4. Identification of test and inspection methods.
 - 5. Number of tests and inspections required.
 - 6. Time schedule or time span for tests and inspections.
 - 7. Entity responsible for performing tests and inspections.
 - 8. Requirements for obtaining samples.
 - 9. Unique characteristics of each quality-control service.
- C. Reports: Prepare and submit certified written reports that include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, and telephone number of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.
 - 9. Test and inspection results and an interpretation of test results.
 - 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - 12. Name and signature of laboratory inspector.
 - 13. Recommendations on retesting and reinspect.
- D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee

payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.6 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. 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.
- F. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
 - 1. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- G. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
 - 2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 - 3. Demonstrate the proposed range of aesthetic effects and workmanship.

4. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
 - a. Allow seven days for initial review and each re-review of each mockup.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove mockups when directed, unless otherwise indicated.

1.7 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor and the Contract Sum will be adjusted by Change Order.
- B. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 1 Section "Submittal Procedures."
- D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

- E. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform any duties of Contractor.
- F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- H. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within 30 days of date established for commencement of the Work.
1. Distribution: Distribute schedule to Owner, Architect testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.8 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
 2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Architect.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 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 1 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 SECTION 01 40 00

SECTION 01 42 00 - REFERENCE STANDARDS AND DEFINITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 DEFINITIONS

- A. General: Basic contract definitions are included in the Conditions of the Contract.
- B. "Indicated": The term "indicated" refers to graphic representations, notes, or schedules on the Drawings; or to other paragraphs or schedules in the Specifications and similar requirements in the Contract Documents. Terms such as "shown," "noted," "scheduled," and "specified" are used to help the user locate the reference. Location is not limited.
- C. "Directed": Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean directed by the Architect, requested by the Architect, and similar phrases.
- D. "Approved": The term "approved," when used in conjunction with the Architect's action on the Contractor's submittals, applications, and requests, is limited to the Architect's duties and responsibilities as stated in the Conditions of the Contract.
- E. "Regulations": The term "regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": The term "furnish" means to supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": The term "install" describes operations at the Project site including the actual unloading, temporary storage, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": The term "provide" means to furnish and install, complete and ready for the intended use.
- I. "Installer": An installer is the Contractor or another entity engaged by the Contractor, either as an employee, subcontractor, or contractor of lower tier, to perform a particular construction activity, including installation, erection, application, or similar operations. Installers are required to be experienced in the operations they are engaged to perform.

1. The term "experienced," when used with the term "installer," means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with the special requirements indicated; and having complied with requirements of authorities having jurisdiction.
 2. Trades: 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 tradespersons of the corresponding generic name.
 3. Assigning Specialists: Certain Sections of the Specifications require that specific construction activities shall be performed by specialists who are recognized experts in those operations. The specialists must be engaged for those activities, and their assignments are requirements over which the Contractor has no option. However, the ultimate responsibility for fulfilling contract requirements remains with the Contractor.
 - a. This requirement shall not be interpreted to conflict with enforcing building codes and similar regulations governing the Work. It is also not intended to interfere with local trade-union jurisdictional settlements and similar conventions.
- J. "Project site" is the space available to the Contractor for performing construction activities, either exclusively or in conjunction with others performing other work as part of the Project. The extent of the Project site is shown on the Drawings and may or may not be identical with the description of the land on which the Project is to be built.
- K. "Testing Agencies": A testing agency is an independent entity engaged to perform specific inspections or tests, either at the Project site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

1.3 SPECIFICATION FORMAT AND CONTENT EXPLANATION

- A. Specification Format: These Specifications are organized into Divisions and Sections based on the CSI/CSC's "MasterFormat" numbering system.
- B. Specification Content: These 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. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be interpolated as the sense requires. Singular words shall be interpreted as plural and plural words interpreted as singular where applicable as the context of the Contract Documents indicates.
 2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by the Contractor. At certain locations in the Section Text, subjective language is used for clarity to describe responsibilities that must be fulfilled indirectly by the Contractor or by others when so noted.

- a. 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.

1.4 INDUSTRY STANDARDS

- A. **Applicability of Standards:** Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. **Publication Dates:** Comply with standards in effect as of the date of the Contract Documents.
- C. **Conflicting Requirements:** Where 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 the Architect for a decision before proceeding.
 1. **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 the requirements. Refer uncertainties to the Architect for a decision before proceeding.
- D. **Copies of Standards:** Each entity engaged in construction on the Project must 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, the Contractor shall obtain copies directly from the publication source and make them available on request.
- E. **Abbreviations and Names:** Trade association names and titles of general standards are frequently abbreviated. Where abbreviations and acronyms are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standards-producing organization, authorities having jurisdiction, or other entity applicable to the context of the text provision. Refer to Gale Research's "Encyclopedia of Associations" or Columbia Books' "National Trade & Professional Associations of the U.S.," which are available in most libraries.

1.5 SUBMITTALS

- A. **Permits, Licenses, and Certificates:** For the Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

PRODUCTS (Not Applicable)

PART 2 - EXECUTION (Not Applicable)

END OF SECTION 01 42 00

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

1.3 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 testing agencies and authorities having jurisdiction.
- B. Sewer Service: Use of the Owner's existing sanitary sewer system is available without metering and without payment charge. Provide connections and extensions of services as required for construction operations.
- C. Water Service: Water is not available at the site. Contractor to provide water to be used by all entities for construction operations.
- D. Electric Power Service: Power is not available at the site. Contractor to provide power to be used by all entities for construction operations.
- E. Telephone Service: Provide temporary phone service to the site as required to contact Contractor site representatives.

1.4 INFORMATIONAL SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
- C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

- D. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.
 - 1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
 - 2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
 - 3. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
- E. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:
 - 1. Locations of dust-control partitions at each phase of work.
 - 2. HVAC system isolation schematic drawing.
 - 3. Location of proposed air-filtration system discharge.
 - 4. Waste handling procedures.
 - 5. Other dust-control measures.

1.5 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Comply with Federal, State and local codes and regulations as well as utility company requirements.
- C. Coordinate work with Owner's requirements.
- D. Materials: Materials must be new and adequate in capacity for the required usage. Materials must not create unsafe conditions nor violate requirements of applicable codes and standards.
- E. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.6 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

- B. Maintain excavations free of water. Provide and operate pumping equipment. Grade site to drain water away from buildings and excavations.
- C. Provide temporary protection for installed products. Control traffic in immediate areas to minimize damage.
- D. Prohibit traffic and storage on waterproofed and roofed surfaces, on lawns and landscaped areas.
- E. Provide temporary ground protection to minimize damage to the existing concrete pathways on site. Refer to drawings for additional information.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.8-mm-) thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized-steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top rails.
- B. Portable Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.8-mm-) thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized-steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top and bottom rails. Provide concrete bases for supporting posts.
- C. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil (0.25-mm) minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.
- D. Dust-Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches (914 by 1624 mm).
- E. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
- F. Lumber and Plywood: Pressure-treated dimension lumber and plywood suitable for exterior exposure.
- G. Paint: Exterior latex primer and matching topcoat.

2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

- B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect/Engineer and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep the office clean and orderly. Furnish and equip offices as follows:
 - 1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
 - 2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- (1.2-m-) square tack and marker boards.
 - 3. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F (20 to 22 deg C).
 - 4. Lighting fixtures capable of maintaining average illumination of 20 fc (215 lx) at desk height.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
 - 1. Store combustible materials apart from building.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. Heating Equipment: Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.

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.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
 1. Connect temporary sewers to the municipal system as directed by authorities having jurisdiction.
- C. Provide potable water for drinking and construction purposes.
 1. The Contractor shall make all necessary arrangements for temporary water service for construction purposes, and furnish at his own expense all piping and accessories required.
 2. Take positive measures to preclude cross-connections and backflow.
 3. The Contractor will assume the cost of water consumed if responsible care and restraint are not exercised by the Contractor in its use.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- E. Construction Aids: The General Contractor and each Subcontractor shall provide construction aids and equipment required by their personnel and to facilitate execution of their Work. Examples are scaffolds, staging, ladders, stairs, ramps, runways, platforms, railings, hoists, cranes, chutes and other such facilities and equipment. Mutual use may be arranged by the Contractor where applicable.
- F. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- G. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
 1. Prior to commencing work, isolate the HVAC system in area where work is to be performed according to coordination drawings.
 - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
 - b. Maintain negative air pressure within work area using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
 2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
 3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

- H. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
 - 1. Provide dehumidification systems when required to reduce substrate moisture levels to the level required to allow installation or application of finishes.
- I. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
 - 1. Install electric power service underground unless otherwise indicated.
- J. 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 the entire system.
 - 2. Install lighting for Project identification sign.
- K. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one telephone line(s) for each field office.
 - 1. Provide additional telephone lines for the following:
 - a. Provide a dedicated telephone line for each facsimile machine in each field office.
 - 2. At each telephone, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.
 - d. Contractor's emergency after-hours telephone number.
 - e. Architect's office.
 - f. Engineers' offices.
 - g. Owner's office.
 - h. Principal subcontractors' field and home offices.
 - 3. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:

1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
 2. Maintain support facilities until Architect/Engineer schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Security: Security of persons and property in the areas under control of the Contractor shall be the Contractor's exclusive responsibility.
1. The Contractor, at his own expense, shall initiate whatever programs that are necessary to execute his responsibility.
 2. Control of access to the area under the Contractor's control shall be maintained. Visitors shall be required to report immediately to the Contractor's Superintendent and to produce full identification which will be recorded in the Contractor's Daily Log along with the purpose of the visit.
- C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 2. Maintain access for fire-fighting equipment and access to fire hydrants and control valves.
 3. Provide and maintain uninterrupted vehicular access to site and within to temporary construction facilities and work areas for persons and equipment involved in the construction of Project.
 4. Maintain traffic areas free of excavated materials, construction equipment, products, snow, ice and debris.
 5. Provide traffic control between staging area (location as noted on the drawings) and the construction entrance (location as noted on the drawings).
- D. Traffic Regulation: Obtain all necessary permits for access to and use of public roads and streets for construction and hauling purposes. Comply with traffic control regulations applying to permit issuance.
1. Provide markers, signs, lights and barriers on and near the site to safely control construction traffic and public access.
- E. Parking: Use designated areas of Owner's existing parking areas for construction personnel's private vehicles and of Contractor's light-weight vehicles.
- F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
1. Identification Signs: Provide Project identification signs as indicated on Drawings.
 2. Temporary Signs: Provide other signs as indicated and as required to inform the public and individuals seeking entrance to Project.
 - a. Provide temporary, directional signs for construction personnel and visitors.

3. Maintain and touchup signs so they are legible at all times.
- G. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- H. Cleaning During Construction: Control accumulation of waste materials and rubbish. Periodically dispose of legally off site.
 1. Clean interior areas prior to the start of finish work. Maintain areas free of dust and other contaminants during finishing operations.
- I. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
 1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- J. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.
 1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.
- K. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.
- L. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
- M. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- N. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings.
 1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant- protection zones.
 2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
 3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
 4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

- O. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- P. Tree and Plant Protection: Comply with requirements specified in Section 015639 "Temporary Tree and Plant Protection."
- Q. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- R. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.
- S. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
 - 1. Extent of Fence: As required to enclose portion of site determined sufficient to accommodate construction operations and maintain security.
 - 2. Maintain security by limiting the number of keys and restricting distribution to authorized personnel. Furnish 10 sets of keys to Owner.
- T. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at the end of each work day.
- U. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- V. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- W. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
- X. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
 - 1. Prohibit smoking in construction areas.
 - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.

3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.4 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.
- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
 1. Protect porous materials from water damage.
 2. Protect stored and installed material from flowing or standing water.
 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 4. Remove standing water from decks.
 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 2. Keep interior spaces reasonably clean and protected from water damage.
 3. Periodically collect and remove waste containing cellulose or other organic matter.
 4. Discard or replace water-damaged material.
 5. Do not install material that is wet.
 6. Discard, replace, or clean stored or installed material that begins to grow mold.
 7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
 1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 2. Use permanent HVAC system to control humidity.
 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
 - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective.
 - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of

- exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
- c. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.5 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. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
 - 3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 01 50 00

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SECTION 01 56 00 - ENVIRONMENTAL PROTECTION

PART 1 - GENERAL

1.1 ENVIRONMENTAL PROTECTION

- A. Environmental protection considerations consist of, but are not limited to, the following factors:
 - 1. Natural resources including air, water, and land.
 - 2. Solid waste disposal.
 - 3. Noise.
 - 4. Control of toxic substances and hazardous materials.
 - 5. The presence of chemical, physical, and biological elements and agents that adversely effect and alter ecological balances.

1.2 GENERAL REQUIREMENTS

- A. Provide and maintain environmental protection defined herein, other Sections and as indicated in the Drawings.
- B. Comply with all Federal, State, and local laws, ordinances and regulations pertaining to environmental protection.
- C. Compliance by subcontractors with the provisions of this and various other sections of these specifications is the responsibility of the Contractor.
- D. Use of equipment from which factory-installed, anti-pollution and noise control devices are removed or rendered ineffective, either intentionally or through lack of proper maintenance is prohibited.
- E. Furnish a certificate that all materials and operating equipment installed as a part of this project, the installation thereof and all equipment used in the construction, are in compliance with all applicable local laws, ordinances, regulations and permits concerning environmental pollution control and abatement.

1.3 PROTECTION OF NATURAL RESOURCES

- A. General: It is intended that the natural resources within the project boundaries and outside the limits of permanent work performed be preserved in their existing condition, be restored to an equivalent of the existing condition or improved as indicated, as approved by the Architect/Engineer, upon completion of the work. Confine on-site construction activities to areas defined by the drawings and specifications.

1.4 TOXIC SUBSTANCES

- B. Asbestos and Hazardous Materials Procedure: In the event the Contractor, during the course of the work on the project, encounters the presence of asbestos or any materials containing asbestos, or polychlorinated biphenyl (PCB's) or any other hazardous materials as recognized by local Authorities having jurisdiction, promptly notify the Owner through the Architect/Engineer. Do not perform any work pertinent to the asbestos or hazardous material prior to receipt of special instructions from the Owner through the Architect/Engineer. Any delay in the progress of the work as a result of encountering either asbestos or hazardous materials on the project will be mitigated by the Architect/Engineer. Within 24 hours of this notification to the Owner through the Architect/Engineer of the encountering of the presence of asbestos or hazardous materials, the Contractor will meet with the Architect/Engineer to replan and work around the affected area. The Architect/Engineer will provide the special instructions without delay and upon confirmation by the local Authorities of the actions taken and authorize work to progress.
 - C. Comply with all applicable provisions of the National Emission Standards for Asbestos (40 CFR 61 Subpart B).
 - D. Comply with the local regulations of polychlorinated biphenyl (PCB). Since these chemicals are used in some existing insulation, existing fixed and vehicular transformers, assure proper marking, handling, and disposal of any PCB's in accordance with the regulations of 40 CFR 761.
 - 1. Do not use PCB chemical substance, mixture, equipment, container, sealant, coating, or dust-control agent except in accordance with regulations of 40 CFR 761.
 - 2. Immediately report any PCB chemical substance, mixture, equipment, container, sealant, coating or dust control agent found stored within the project area to the Architect in writing and stop work in the area.
 - E. Lead paint is not known to be present in cite elements containing lead.
 - F. Asbestos is not known to be present in cite elements containing asbestos.
- 1.5 CONTROL AND DISPOSAL OF EXCESS MATERIAL, TRASH AND DEBRIS
- A. Dispose of excess excavated material that is approved by the Architect/Engineer as clean fill onsite if an onsite soil disposal area is approved by the Architect/Engineer. If no such site is approved, dispose of the material in accordance with the provision of paragraph 1.5 (C).
 - B. Pick-up trash and place in containers. Empty containers on a regular schedule. Conduct handling and disposal to prevent contamination of the site and other areas. Do not dispose of in areas of natural vegetation. On completion, leave the area clean and natural looking.
 - C. Dispose of rubbish and debris as follows:
 - 1. Transport all waste off the site and dispose of it in a manner that complies with State, and local requirements. Secure a permit or license prior to transporting any material off the site. Do not burn or bury waste materials on the site.

1.6 CONTROL AND DISPOSAL OF CHEMICAL AND SANITARY WASTES

- A. Store chemical waste in corrosion-resistant containers, remove from the project site, and dispose of as necessary, but not less frequently than monthly. Provide for disposal of chemical waste in accordance with standard established practices as approved by the Architect. Dispose of lubricants to be discarded in accordance with approved procedures meeting state, and local regulations.

1.7 DUST CONTROL

- A. Keep dust down at all times including nonworking hours, weekends, and holidays.
- B. Secure and cover transport equipment and loose materials in transit to ensure that materials do not become airborne during transit.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 56 00

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SECTION 01 56 39 - TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes general protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.
- B. Related Sections:
 - 1. Section 015000 "Temporary Facilities and Controls" for temporary site fencing.
 - 2. Section 311000 "Site Clearing" for removing existing trees and shrubs.

1.3 DEFINITIONS

- A. Caliper: Diameter of a trunk measured by a diameter tape at 6 inches (150 mm) above the ground for trees up to, and including, 4-inch (100-mm) size; and 12 inches (300 mm) above the ground for trees larger than 4-inch (100-mm) size.
- B. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.
- C. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated.
- D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 PREINSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site
 - 1. Review methods and procedures related to temporary tree and plant protection
 - 2. including, but not limited to, the following:
 - a. Tree-service firm's personnel and equipment needed to make progress and avoid delays.
 - b. Arborist's responsibilities
 - c. Quality control program

- d. Coordination of work and equipment movement within and around the locations of protection zones
- e. Trenching by hand or with air space within and around protection zones
- f. Field quality control

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each type of the following:
 - 1. Organic Mulch: 1-pint (0.5-L) volume of organic mulch; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch.
 - 2. Protection-Zone Fencing: Assembled Samples of manufacturer's standard size made from full-size components.
 - 3. Protection-Zone Signage: Full-size Samples of each size and text, ready for installation.
- C. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.
 - 1. Species and size of tree.
 - 2. Location on site plan. Include unique identifier for each.
 - 3. Reason for pruning.
 - 4. Description of pruning to be performed.
 - 5. Description of maintenance following pruning.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified arborist and tree service firm.
- B. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.
- C. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.
- D. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.
 - 1. Use sufficiently detailed photographs or videotape.
 - 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

1.7 QUALITY ASSURANCE

- A. Arborist Qualifications: Certified Arborist as certified by ISA.
- B. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed temporary tree and plant protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.
- C. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:
 - a. Construction schedule. Verify availability of materials, personnel, and equipment needed to make progress and avoid delays.
 - b. Enforcing requirements for protection zones.
 - c. Arborist's responsibilities.
 - d. Field quality control.

1.8 PROJECT CONDITIONS

- A. 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.
- B. Do not direct vehicle or equipment exhaust toward protection zones.
- C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Topsoil: Natural or cultivated top layer of the soil profile or manufactured topsoil; containing organic matter and sand, silt, and clay particles; 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 more than 1 inch (25 mm) in diameter; and free of weeds, roots, and toxic and other nonsoil materials.

1. Obtain topsoil only from well-drained sites where topsoil is 4 inches (100 mm) deep or more; do not obtain from bogs or marshes.
- B. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:
 1. Type: Shredded hardwood.
 2. Size Range: 3 inches (76 mm) maximum, 1/2-inch (13 mm) minimum.
 3. Color: Natural.
- C. Protection-Zone Fencing: Fencing fixed in position and meeting one of the following requirements.
 1. Chain-Link Protection-Zone Fencing: Galvanized-steel fencing fabricated from minimum 2-inch (50-mm) opening, 0.148-inch- (3.76-mm-) diameter wire chain-link fabric; with pipe posts, minimum 2-3/8-inch- (60-mm-) OD line posts, and 2-7/8-inch- (73-mm-) OD corner and pull posts; with 1-5/8-inch- (42-mm-) OD top rails; with 0.177-inch- (4.5-mm-) diameter top tension wire and 0.177-inch- (4.5-mm-) diameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system.
 - a. Height: 4 feet (1.2 m).
 2. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch (50-mm) maximum opening in pattern and weighing a minimum of 0.4 lb/ft. (0.6 kg/m); remaining flexible from minus 60 to plus 200 deg F (minus 16 to plus 93 deg C); inert to most chemicals and acids; minimum tensile yield strength of 2000 psi (13.8 MPa) and ultimate tensile strength of 2680 psi (18.5 MPa); secured with plastic bands or galvanized-steel or stainless-steel wire ties; and supported by tubular or T-shape galvanized-steel posts spaced not more than 8 feet (2.4 m) apart.
 - a. Height: 4 feet (1.2 m).
 - b. Color: High-visibility orange, nonfading.
- D. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering and as follows:
 1. Size and Text: DO NOT ENTER. TREE PROTECTION ZONE.
 2. Lettering: 3-inch- (75-mm-) high minimum, white characters on red background.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- B. For the record, prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

3.2 PREPARATION

- A. Locate and clearly identify trees, shrubs, and other vegetation to remain. Flag each tree trunk at 54 inches (1372 mm) above the ground.
- B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.
- C. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated.
 - 1. Apply 4-inch (100-mm) average thickness of organic mulch. Do not place mulch within 6 inches (150 mm) of tree trunks.

3.3 TREE- AND PLANT-PROTECTION ZONES

- A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people from easily entering protected area except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.
 - 1. Chain-Link Fencing: Install to comply with ASTM F 567 and with manufacturer's written instructions.
 - 2. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.
- B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Architect. Install one sign spaced approximately every 20 feet (6 m) on protection-zone fencing, but no fewer than one sign with each facing a different direction.
- C. Maintain protection zones free of weeds and trash.

- D. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.
- E. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.
 - 1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
 - 2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

3.4 EXCAVATION

- A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Section 312000 "Earth Moving."
- B. Trenching near Trees: Where utility trenches are required within protection zones, hand excavate under or around tree roots or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning.
- C. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches (75 mm) back from new construction and as required for root pruning.
- D. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3.5 ROOT PRUNING

- A. Prune roots that are affected by temporary and permanent construction. Prune as follows:
 - 1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
 - 2. Cut Ends: Coat cut ends of roots more than 1-1/2 inches (38 mm) in diameter with an emulsified asphalt or other coating formulated for use on damaged plant tissues and that is acceptable to arborist.
 - 3. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
 - 4. Cover exposed roots with burlap and water regularly.

5. Backfill as soon as possible according to requirements in Section 312000 "Earth Moving."

- B. Root Pruning at Edge of Protection Zone: Prune roots 6 inches (150 mm) inside of the protection zone, by cleanly cutting all roots to the depth of the required excavation.
- C. Root Pruning within Protection Zone: Clear and excavate by hand to the depth of the required excavation to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

3.6 CROWN PRUNING

- A. Prune branches that are affected by temporary and permanent construction. Prune branches as follows:
 - 1. Prune trees to remain to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by arborist.
 - 2. Pruning Standards: Prune trees according to ANSI A300 (Part 1) and the following:
 - a. Type of Pruning: Cleaning.
 - 3. Cut branches with sharp pruning instruments; do not break or chop.
 - 4. Do not apply pruning paint to wounds.
- B. Chip removed branches and spread over areas identified by Architect.

3.7 REGRADING

- A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.
- B. Lowering Grade within Protection Zone: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by arborist unless otherwise indicated.
 - 1. Root Pruning: Prune tree roots exposed by lowering the grade. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots as required for root pruning.
- C. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.
- D. Minor Fill within Protection Zone: Where existing grade is 2 inches (50 mm) or less below elevation of finish grade, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations.

3.8 FIELD QUALITY CONTROL

- A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.9 REPAIR AND REPLACEMENT

- A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.
 - 1. Submit details of proposed root cutting and tree and shrub repairs.
 - 2. Have arborist perform the root cutting, branch pruning, and damage repair of trees and shrubs.
 - 3. Treat damaged trunks, limbs, and roots according to arborist's written instructions.
 - 4. Perform repairs within 24 hours.
 - 5. Replace vegetation that cannot be repaired and restored to full-growth status, as determined by Architect.
- B. Trees: Remove and replace trees indicated to remain 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 and species as those being replaced for each tree that measures 6 inches (150 mm) or smaller in caliper size.
 - a. Species: Match existing tree to be replaced.
- C. Soil Aeration: Where directed by Architect, aerate surface soil compacted during construction. Aerate 10 feet (3 m) beyond drip line and no closer than 36 inches (900 mm) to tree trunk. Drill 2-inch- (50-mm-) diameter holes a minimum of 12 inches (300 mm) deep at 24 inches (600 mm) o.c. Backfill holes with an equal mix of augered soil and sand.

3.10 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove excess excavated material, displaced trees, trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 01 56 39

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This 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; product substitutions; and comparable products.
- B. Related Sections include but are not limited to the following:
 - 1. Division 1 Section "References" for applicable industry standards for products specified.
 - 2. Division 1 Section "Closeout Procedures" for submitting warranties for Contract closeout.
 - 3. Other included Sections for specific requirements for warranties on products and installations specified to be warranted.

1.3 DEFINITIONS

- A. Products: Items purchased 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, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

- C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," 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 other named manufacturers.

1.4 SUBMITTALS

- A. Product List: Submit a list, in tabular form, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.
 - 1. Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.
 - 2. Form: Tabulate information for each product under the following column headings:
 - a. Specification Section number and title.
 - b. Generic name used in the Contract Documents.
 - c. Proprietary name, model number, and similar designations.
 - d. Manufacturer's name and address.
 - e. Supplier's name and address.
 - f. Installer's name and address.
 - g. Projected delivery date or time span of delivery period.
 - h. Identification of items that require early submittal approval for scheduled delivery date.
 - 3. Initial Submittal: Within 30 days after date of commencement of the Work, submit 3 copies of initial product list. Include a written explanation for omissions of data and for variations from Contract requirements.
 - a. At Contractor's option, initial submittal may be limited to product selections and designations that must be established early in Contract period.
 - 4. Completed List: Within 60 days after date of commencement of the Work, submit 3 copies of completed product list. Include a written explanation for omissions of data and for variations from Contract requirements.
 - 5. Architect's Action: Architect will respond in writing to Contractor within 15 days of receipt of completed product list. Architect's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Architect's response, or lack of response, does not constitute a waiver of requirement to comply with the Contract Documents.
- B. 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 at the end of this section.

2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified material or product cannot be provided.
 - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 - g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
 - i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
 - 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 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/Engineer's Action: If necessary, Architect/Engineer will request additional information or documentation for evaluation within 7 days of receipt of a request for substitution. Architect/Engineer will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
 - a. Form of Acceptance: Change Order.
 - b. Use product specified if Architect/Engineer cannot make a decision on use of a proposed substitution within time allocated.
- C. Comparable Product 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. Architect's Action: If necessary, Architect/Engineer will request additional information or documentation for evaluation within one week of receipt of a comparable product

request. Architect/Engineer will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.

- a. Form of Approval: As specified in Division 1 Section "Submittal Procedures."
- b. Use product specified if Architect cannot make a decision on use of a comparable product request within time allocated.

- D. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 1 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, product selected shall be 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/Engineer 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. 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 ensure compliance with the Contract Documents and to ensure 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. Store cementitious products and materials on elevated platforms.

5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.
8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final 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 appropriate form properly executed.
 3. Refer to Divisions 2 through 33 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Division 1 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that 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. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in Part 2 "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
5. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
6. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
7. Product Options: Where Specifications indicate that sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specified product or system. Comply with provisions in Part 2 "Product Substitutions" Article for consideration of an unnamed product or system.
8. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified 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 provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product by the other named manufacturers.
9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches Architect's/Engineer's sample. Architect's decision will be final on whether a proposed product matches.
 - a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.

10. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.
 - a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.
 - b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 PRODUCT SUBSTITUTIONS

- A. Timing: Architect will consider requests for substitution if received within **30** days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.
- B. Conditions: Architect/Engineer 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:
 1. 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.
 2. Requested substitution does not require extensive revisions to the Contract Documents.
 3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 4. Substitution request is fully documented and properly submitted.
 5. Requested substitution will not adversely affect Contractor's Construction Schedule.
 6. Requested substitution has received necessary approvals of authorities having jurisdiction.
 7. Requested substitution is compatible with other portions of the Work.
 8. Requested substitution has been coordinated with other portions of the Work.
 9. Requested substitution provides specified warranty.
 10. 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.

2.3 COMPARABLE PRODUCTS

- A. Conditions: Architect/Engineer will consider Contractor's request for comparable product 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:

1. Evidence that the proposed product does not require extensive 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)



SUBSTITUTION REQUEST

(After the Bidding/Negotiating Phase)

Project: _____ Substitution Request Number: _____

From: _____
To: _____ Date: _____

A/E Project Number: _____
Re: _____ Contract For: _____

Specification Title: _____ Description: _____
Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____
Manufacturer: _____ Phone: _____
Address: _____
Trade Name: _____ Model No.: _____
Installer: _____ Phone: _____
Address: _____

History: ☐ New product ☐ 1-4 years old ☐ 5-10 years old ☐ More than 10 years old

Differences between proposed substitution and specified product:

☐ Point-by-point comparative data attached — REQUIRED BY A/E

Reason for not providing specified item:

Similar Installation

Project: _____ Architect: _____
Address: _____ Owner: _____
_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain _____

Savings to Owner for accepting substitution: _____ (\$ _____)

Proposed substitution changes Contract Time: ☐ No ☐ Yes [Add] [Deduct] _____ days.

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ _____

SUBSTITUTION REQUEST

(After the Bidding/Negotiating Phase — Continued)

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

Telephone: _____

Attachments: ☐

A/E's REVIEW AND ACTION

- ☐ Substitution approved - Make submittals in accordance with Specification Section 01 25 00 Substitution Procedures.
- ☐ Substitution approved as noted - Make submittals in accordance with Specification Section 01 25 00 Substitution Procedures
- ☐ Substitution rejected - Use specified materials.
- ☐ Substitution Request received too late - Use specified materials.

Signed by: _____ Date: _____

Additional Comments: ☐ Contractor ☐ Subcontractor ☐ Supplier ☐ Manufacturer ☐ A/E

☐ Other: _____

END OF SECTION 0 160 00

SECTION 01 73 00 – EXECUTION REEQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. General installation of products.
 - 3. Coordination of Owner-installed products.
 - 4. Progress cleaning.
 - 5. Starting and adjusting.
 - 6. Protection of installed construction.
 - 7. Correction of the Work.
- B. Related Sections include the following:
 - 1. Division 1 Section "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
 - 2. Division 1 Section "Cutting and Patching" for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.
 - 3. Division 1 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.
 - 4. Division 02 Section "Selective Demolition" for demolition and removal of selected portions of the building.

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. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - a. Description of the Work.
 - b. List of detrimental conditions, including substrates.
 - c. List of unacceptable installation tolerances.
 - d. Recommended corrections.
 2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents. Submit requests on CSI Form 13.2A, "Request for Interpretation."

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. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.
- C. Building Lines and Levels: Locate and lay out control lines and levels for foundations including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations from two or more locations.
- D. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 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.
 - 4. Maintain minimum headroom clearance of 8 feet (2.4 m) in spaces without a suspended ceiling.
- 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 produces 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/engineer.
 - 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.

3.5 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction forces.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction forces.
 - 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 - 2. Preinstallation Conferences: Include Owner's construction forces at pre-installation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction forces if portions of the Work depend on Owner's construction.

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. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F (27 deg C).
 3. 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 1 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 manufacturers' 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 1 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 73 00

SECTION 01 73 29 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.
- B. Related Sections include the but are not limited to the following:
 - 1. Division 2 Section "Selective Demolition" for demolition of selected portions of the building for alterations.

1.3 DEFINITIONS

- A. Cutting: Removal of existing construction necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
- B. Operational Elements: Do not cut and patch the following operating elements and related components in a manner that results in reducing their capacity to perform as intended or that result in increased maintenance or decreased operational life or safety.
 - 1. Primary operational systems and equipment.
 - 2. Fire-protection systems.
 - 3. Control systems.
 - 4. Communication systems.
 - 5. Electrical wiring systems.
- C. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity, which results in reducing their capacity to perform as intended, or that result in increased maintenance or decreased operational life or safety.

1. Water, moisture, or vapor barriers.
 2. Membranes and flashings.
 3. Piping and ductwork.
- D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- E. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections of these Specifications.
- B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.

- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

3.3 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete & Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Division 2 Sections where required by cutting and patching operations.
 - 5. Proceed with patching after construction operations requiring cutting are complete.
- C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
 - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

- a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
4. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

END OF SECTION 01 73 29

SECTION 01 74 19 - CONSTRUCTION WASTE MANAGEMENT

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes: Administrative and procedural requirements for construction waste management activities.

1.2 DEFINITIONS

- A. Construction, Demolition, and Land clearing (CDL) Waste: Includes all non-hazardous solid wastes resulting from construction, remodeling, alterations, repair, demolition and land clearing. Includes material that is recycled, reused, salvaged or disposed as garbage.
- B. Salvage: Recovery of materials for on-site reuse, sale or donation to a third party.
- C. Reuse: Making use of a material without altering its form. Materials can be reused on-site or reused on other projects off-site. Examples include, but are not limited to the following: Crushing or grinding of concrete for use as sub-base material. Chipping of land clearing debris for use as mulch.
- D. Recycling: The process of sorting, cleaning, treating, and reconstituting materials for the purpose of using the material in the manufacture of a new product.
- E. Source-Separated CDL Recycling: The process of separating recyclable materials in separate containers as they are generated on the job-site. The separated materials are hauled directly to a recycling facility or transfer station.
- F. Co-mingled CDL Recycling: The process of collecting mixed recyclable materials in one container on-site. The container is taken to a material recovery facility where materials are separated for recycling.
- G. Approved Recycling Facility: Any of the following:
 - 1. A facility that can legally accept CDL waste materials for the purpose of processing the materials into an altered form for the manufacture of a new product.
 - 2. Material Recovery Facility: A general term used to describe a waste-sorting facility. Mechanical, hand-separation, or a combination of both procedures, are used to recover recyclable materials.
- H. Universal waste components (UWC) are as follows: electric motors, PCB ballasts, non-PCB ballasts, capacitors, contactors, circuit breakers, elemental and liquid mercury containing articles, transformers, lead acid batteries, fluorescent light bulbs, and all HID light bulbs.

1.3 SUBMITTALS

- A. Contractor shall develop a Waste Management Plan: Submit 3 copies of plan within 14 days of date established for the **Notice to Proceed**.
- B. Contractor shall provide Waste Management Report: Concurrent with each Application for Payment, submit **3** copies of report.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Divert a minimum of **75%** CDL waste, by weight, from the landfill by one, or a combination of the following activities:
 - 1. Salvage
 - 2. Reuse
 - 3. Source-Separated CDL Recycling
 - 4. Co-mingled CDL Recycling
- B. CDL waste materials that can be salvaged, reused or recycled include, but are not limited to, the following:
 - 1. Acoustical ceiling tiles
 - 2. Asphalt
 - 3. Asphalt shingles
 - 4. Cardboard packaging
 - 5. Carpet and carpet pad
 - 6. Concrete
 - 7. Drywall
 - 8. Fluorescent lights and ballasts
 - 9. Land clearing debris (vegetation, stumpage, dirt)
 - 10. Metals
 - 11. Paint (through hazardous waste outlets)
 - 12. Wood
 - 13. Plastic film (sheeting, shrink wrap, packaging)
 - 14. Window glass
 - 15. Wood
 - 16. Field office waste, including office paper, aluminum cans, glass, plastic, and office cardboard.

1.5 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: Experienced firm, with a record of successful waste management coordination of projects with similar requirements, that employs a LEED Accredited Professional, certified by the USGBC as waste management coordinator.
- B. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

- C. Regulatory Requirements: Conduct construction waste management activities in accordance with hauling and disposal regulations of all authorities having jurisdiction and all other applicable laws and ordinances.
- D. Preconstruction Conference: Schedule and conduct meeting at Project site prior to construction activities.
 - 1. Attendees: Inform the following individuals, whose presence is required, of date and time of meeting.
 - a. Owner
 - b. Architect
 - c. Contractor's superintendent
 - d. Major subcontractors
 - e. Waste Management Coordinator
 - f. Other concerned parties.
 - 2. Agenda Items: Review methods and procedures related to waste management including, but not limited to, the following:
 - a. Review and discuss waste management plan including responsibilities of Waste Management Coordinator.
 - b. Review requirements for documenting quantities of each type of waste and its disposition.
 - c. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
 - d. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
 - e. Review waste management requirements for each trade.
 - 3. Minutes: Record discussion. Distribute meeting minutes to all participants.
Note: If there is a Project Architect, they will perform this role.

1.6 WASTE MANAGEMENT PLAN – Contactor shall develop and document the following:

- A. Develop a plan to meet the requirements listed in this section at a minimum. Plan shall consist of waste identification, waste reduction plan and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight throughout the plan.
- B. Indicate anticipated types and quantities of demolition, site-cleaning and construction waste generated by the project. List all assumptions made for the quantities estimates.
- C. List each type of waste and whether it will be salvaged, recycled, or disposed of in an landfill. The plan should included the following information:
 - 1. Types and estimated quantities, by weight, of CDL waste expected to be generated during demolition and construction.

2. Proposed methods for CDL waste salvage, reuse, recycling and disposal during demolition including, but not limited to, one or more of the following:
 - a. Contracting with a deconstruction specialist to salvage materials generated,
 - b. Selective salvage as part of demolition contractor's work,
 - c. Reuse of materials on-site or sale or donation to a third party.
 3. Proposed methods for salvage, reuse, recycling and disposal during construction including, but not limited to, one or more of the following:
 - a. Requiring subcontractors to take their CDL waste to a recycling facility;
 - b. Contracting with a recycling hauler to haul recyclable CDL waste to an approved recycling or material recovery facility;
 - c. Processing and reusing materials on-site;
 - d. Self-hauling to a recycling or material recovery facility.
 4. Name of recycling or material recovery facility receiving the CDL wastes.
 5. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on project site where materials separation will be located.
- D. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Include the following:
1. Total quantity of waste.
 2. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.
 3. Total cost of disposal (with no waste management).
 4. Revenue from salvaged materials.
 5. Revenue from recycled materials.
 6. Savings in hauling and tipping fees by donating materials.
 7. Savings in hauling and tipping fees that are avoided.
 8. Handling and transportation costs. Including cost of collection containers for each type of waste.
 9. Net additional cost or net savings from waste management plan.

PART 2 - PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 CONSTRUCTION WASTE MANAGEMENT, GENERAL

- A. Provide containers for CDL waste that is to be recycled clearly labeled as such with a list of acceptable and unacceptable materials. The list of acceptable materials must be the same as the materials recycled at the receiving material recovery facility or recycling processor.

- B. The collection containers for recyclable CDL waste must contain no more than 10% non-recyclable material, by volume.
- C. Provide containers for CDL waste that is disposed in a landfill clearly labeled as such.
- D. Use detailed material estimates to reduce risk of unplanned and potentially wasteful cuts.
- E. To the greatest extent possible, include in material purchasing agreements a waste reduction provision requesting that materials and equipment be delivered in packaging made of recyclable material, that they reduce the amount of packaging, that packaging be taken back for reuse or recycling, and to take back all unused product. Insure that subcontractors require the same provisions in their purchase agreements.
- F. Conduct regular visual inspections of dumpsters and recycling bins to remove contaminants.

3.2 SOURCE SEPARATION

- A. General: Contractor shall separate recyclable materials from CDL waste to the maximum extent possible.

Separate recyclable materials by type.

- 1. Provide containers, clearly labeled, by type of separated materials or provide other storage method for managing recyclable materials until they are removed from Project site.
- 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water and to minimize pest attraction. Cover to prevent windblown dust.
- 3. Stockpile materials away from demolition area. Do not store within drip line of remaining trees.
- 4. Store components off the ground and protect from weather.

3.3 CO-MINGLED RECYCLING

- A. General: Do not put CDL waste that will be disposed in a landfill into a co-mingled CDL waste recycling container.

3.4 REMOVAL OF CONSTRUCTION WASTE MATERIALS

- A. Remove CDL waste materials from project site on a regular basis. Do not allow CDL waste to accumulate on-site.
- B. Transport CDL waste materials off Owner's property and legally dispose of them.
- C. Burning of CDL waste is not permitted.

3.5 UNIVERSAL WASTE DIVERSION

- A. Remove all universal waste from fixtures, panels, and related devices for proper diversion and reclamation.
- B. Store all universal waste in containers provided by contact person within facilities operations.
- C. Store all universal waste in a secured location and request periodic removal from assigned contact person.
- D. Exemption: electric motors, circuit breakers, transformers and lighting contactors are exempt from this provision provided the contractor chooses to salvage or reuse the components.
- E. No identified universal waste will be discarded into the waste stream.

END OF SECTION 01 74 19

WASTE MANAGEMENT PROGRESS REPORT				
MATERIAL CATEGORY	DISPOSED IN MUNICIPAL SOLID WASTE LANDFILL	DIVERTED FROM LANDFILL BY RECYCLING, SALVAGE OR REUSE		
		Recycled	Salvaged	Reused
1. Acoustical Ceiling Tiles				
2. Asphalt				
3. Asphalt Shingles				
4. Cardboard Packaging				
5. Carpet and Carpet Pad				
6. Concrete				
7. Drywall				
8. Fluorescent Lights and Ballasts				
9. Land Clearing Debris (vegetation, stumpage, dirt)				
10. Metals				
11. Paint (through hazardous waste outlets)				
12. Wood				
13. Plastic Film (sheeting, shrink wrap, packaging)				
14. Window Glass				
15. Field Office Waste (office paper, aluminum cans, glass, plastic, and coffee cardboard)				
16. Other (insert description)				
17. Other (insert description)				
Total (In Weight)		(TOTAL OF ALL ABOVE VALUES – IN WEIGHT)		
		Percentage of Waste Diverted	(TOTAL WASTE DIVIDED BY TOTAL DIVERTED)	

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SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Inspection procedures.
 - 2. Project Record Documents.
 - 3. Operation and maintenance manuals.
 - 4. Warranties.
 - 5. Instruction of Owner's personnel.
 - 6. Final cleaning.
- B. Related Sections include the following:
 - 1. Division 1 Section "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
 - 2. Division 1 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 3. Division 1 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 4. Divisions 02 through 33 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 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. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
 - 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.

5. Prepare and submit Project Record Documents, operation and maintenance manuals, damage or settlement surveys, and similar final record information.
 6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
 7. Complete startup testing of systems.
 8. Submit test/adjust/balance records.
 9. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 10. Advise Owner of changeover in heat and other utilities.
 11. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
 12. Complete final cleaning requirements, including touchup painting.
 13. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect/Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect/Engineer will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect/Engineer, that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for Final Completion.

1.4 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 according to Division 1 Section "Payment Procedures."
 2. Submit certified copy of Architect's/Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect/Engineer. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Submit pest-control final inspection report and warranty.
 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training videotapes.
- B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect/Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will

notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Preparation: Submit three copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.

1.6 PROJECT RECORD DOCUMENTS

- A. General: Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.
- B. Record Drawings: Maintain and submit one original set of blue- or black-line white prints with two copies of Contract Drawings and Shop Drawings.

1. 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 cannot be readily identified and recorded later.
 - b. Accurately record information in an understandable drawing technique.
 - c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
 - d. Mark Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on Contract Drawings.

2. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
 3. Mark important additional information that was either shown schematically or omitted from original Drawings.
 4. Note Construction Change Directive numbers, Change Order numbers, alternate numbers, and similar identification where applicable.
 5. Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location. Organize into manageable sets; bind each set with durable paper cover sheets. Include identification on cover sheets.
- C. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications. Mark copy 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. Note related Change Orders, Record Drawings, and Product Data, where applicable.
- D. Record Product Data: Submit three copies of each Product Data submittal. Mark one set to indicate the actual product installation where installation varies substantially from that indicated in Product Data.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 3. Note related Change Orders, Record Drawings, and Record Specifications, where applicable.
- E. Miscellaneous Record Submittals: Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

1.7 OPERATION AND MAINTENANCE MANUALS

- A. Assemble three complete sets of operation and maintenance data indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Sections and as follows:
1. Maintenance Data:
 - a. Manufacturer's information, including list of spare parts.
 - b. Name, address, and telephone number of Installer or supplier.
 - c. Maintenance procedures.
 - d. Maintenance and service schedules for preventive and routine maintenance.

- e. Maintenance record forms.
 - f. Sources of spare parts and maintenance materials.
 - g. Copies of maintenance service agreements.
 - h. Copies of warranties and bonds.
- B. Organize operation and maintenance manuals into suitable sets of manageable size. Bind and index data in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, with pocket inside the covers to receive folded oversized sheets. Identify each binder on front and spine with the printed title "OPERATION AND MAINTENANCE MANUAL," Project name, and subject matter of contents.

1.8 WARRANTIES

- A. 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.
- B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
 - 1. Bind warranties and bonds 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 warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
- C. Provide additional copies of each warranty to include in each operation and maintenance manual.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a 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. Provide a magnetic sweep of all areas around the building to retrieve stray nails, screws and other fasteners or metal shards.
 - 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. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - g. Sweep concrete floors broom clean in unoccupied spaces.
 - h. Clean transparent materials, including glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.
 - i. Remove labels that are not permanent.
 - j. 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.
 - k. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
- C. 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 77 00

SECTION 01 78 23 – OPERATIONS 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for preparing maintenance manuals, including the following:
 - 1. Maintenance documentation directory.
 - 2. Maintenance manuals for the care and maintenance of products, and materials.
- B. Related Sections include but are not limited to the following:
 - 1. Division 1 Section "Submittal Procedures" for submitting copies of submittals for maintenance manuals.
 - 2. Division 1 Section "Closeout Procedures" for submitting maintenance manuals.
 - 3. Division 1 Section "Project Record Documents" for preparing Record Drawings for maintenance manuals.
 - 4. Divisions 02 through 33 Sections for specific maintenance manual requirements for the Work in those Sections.

1.3 SUBMITTALS

- A. Final Submittal: Submit 1 copy of each manual in final form at least 15 days before final inspection. Architect will return copy with comments within 15 days after final inspection.
 - 1. Correct or modify each manual to comply with Architect's/Engineer's comments. Submit 3 copies of each corrected manual within 15 days of receipt of Architect's/Engineer's comments.

1.4 COORDINATION

- A. Where maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

PART 2 - PRODUCTS

2.1 MAINTENANCE DOCUMENTATION DIRECTORY

- A. Organization: Include a section in the directory for each of the following:
 - 1. List of documents.
 - 2. Table of contents.
- B. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

2.2 MANUALS, GENERAL

- 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: Enclose title page in transparent plastic sleeve. Include the following information:
 - 1. Subject matter included in manual.
 - 2. Name and address of Project.
 - 3. Name and address of Owner.
 - 4. Date of submittal.
 - 5. Name, address, and telephone number of Contractor.
 - 6. Name and address of Architect/Engineer.
- 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 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.
 - 1. Binders: Heavy-duty, 3-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 "MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
- 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. 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 diskettes for computerized electronic equipment.
 - 4. Supplementary Text: Prepared on 8-1/2-by-11-inch, 20-lb/sq. ft. 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 PRODUCT MAINTENANCE MANUAL

- 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.
- C. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
 - 4. Material and chemical composition.
 - 5. Reordering information for specially manufactured products.
- 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. List of cleaning agents and methods of cleaning detrimental to product.
 - 4. Schedule for routine cleaning and maintenance.
 - 5. 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.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to operation and maintenance manuals.
- B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- C. 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.
- D. 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.
- E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
 - 1. Do not use original Project Record Documents as part of maintenance manuals.
 - 2. Comply with requirements of newly prepared Record Drawings in Division 1 Section "Project Record Documents."
- F. Comply with Division 1 Section "Closeout Procedures" for the schedule for submitting maintenance documentation.

END OF SECTION 01 78 23

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 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. Related Sections include but are not limited to the following:
 - 1. Division 1 Section "Closeout Procedures" for general closeout procedures and maintenance manual requirements.
 - 2. Division 1 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 3. Divisions 02 through 33 Sections for specific requirements for project record documents of the Work in those Sections.

1.3 SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit copies of Record Drawings as follows:
 - a. Final Submittal: Submit two sets of marked-up Record Prints. Print each Drawing, whether or not changes and additional information were recorded.
- B. Record Specifications: Submit two copies of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit two copies of each Product Data submittal.
 - 1. Where Record Product Data is required as part of operation and maintenance manuals, submit marked-up Product Data as an insert in the manual instead of submittal as Record Product Data.

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. Accurately record information in an understandable drawing technique.
 - c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations below first floor.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 3. Mark the Contract Drawings 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.
 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Prints: Immediately before inspection for Certificate of Substantial Completion, review marked-up Record Prints with Architect. When authorized, prepare a full set of corrected drawings and electronic files (PDF) of the Contract Drawings and Shop Drawings.

1. Incorporate changes and additional information previously marked on Record Prints. Erase, redraw, and add details and notations where applicable.
 2. Refer instances of uncertainty to Architect for resolution.
 3. Print the Contract Drawings and Shop Drawings.
- C. 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. Record CAD Drawings: Organize CAD information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each CAD file.
 3. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect/Engineer.
 - e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
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 the manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
 5. Note related Change Orders, Record Drawings, and Product Data where applicable.

2.3 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 3. Note related Change Orders, Record Drawings, and Product Data where applicable.

2.4 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

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/Engineer's reference during normal working hours.

END OF SECTION 01 78 39

SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
 - 3. Demonstration and training videotapes.
- B. See Divisions 2 through 33 Sections for specific requirements for demonstration and training for products in those Sections.

1.2 SUBMITTALS

- A. Instruction Program: Submit two copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
- B. Demonstration and Training CDs/Flash Drives: Submit two copies within seven days of end of each training module.

1.3 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 1 Section "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Pre-instruction Conference: Conduct conference at Project site. Review methods and procedures related to demonstration and training.
- D. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include system and equipment descriptions, operating standards, regulatory requirements, equipment function, operating characteristics, limiting conditions, and performance curves.
 - 2. Documentation: Review emergency, operations, and maintenance manuals; Project Record Documents; identification systems; warranties and bonds; and maintenance service agreements.
 - 3. Emergencies: Include instructions on stopping; shutdown instructions; operating instructions for conditions outside normal operating limits; instructions on meaning of warnings, trouble indications, and error messages; and required sequences for electric or electronic systems.
 - 4. Operations: Include startup, break-in, control, and safety procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; operating procedures for emergencies and equipment failure; and required sequences for electric or electronic systems.
 - 5. Adjustments: Include alignments and checking, noise, vibration, economy, and efficiency adjustments.
 - 6. Troubleshooting: Include diagnostic instructions and test and inspection procedures.
 - 7. Maintenance: Include inspection procedures, types of cleaning agents, methods of cleaning, procedures for preventive and routine maintenance, and instruction on use of special tools.
 - 8. Repairs: Include diagnosis, repair, and disassembly instructions; instructions for identifying parts; and review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Owner will describe Owner's operational philosophy.
- C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 1. Schedule training with Owner, through Architect, with at least seven days' advance notice.
- D. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.

3.2 DEMONSTRATION AND TRAINING RECORD

- A. General: Engage a qualified commercial photographer to record demonstration and training sessions. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
 1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Video Format: Provide high-quality color video saved on CD's or flash drives. Save in a format acceptable to the Owner.
- C. Narration: Describe scenes on video by dubbing audio narration off-site after session is recorded. Include description of items being viewed. Describe vantage point, indicating location, direction (by compass point), and elevation or story of construction.

END OF SECTION 01 79 00

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SECTION 02 32 00 - GEOTECHNICAL INVESTIGATION

PART 1 GENERAL

1.1 SUMMARY

- A. The following soils report and additional test report information was utilized during the design phases and is included with the project manual: Soils Report Titled "Report of Subsurface Exploration and Geotechnical Consulting Services" dated July 5, 2024, prepared by John D. Hynes & Associate, Inc..

1.2 SITE CONDITIONS

A. Site Information

1. Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings.
2. It is to be expressly understood that the Owner will not be responsible for interpretations or conclusions drawing there from by Contractor. Data is made available for convenience of Contractor.
3. The locations of test borings at various points are shown in the report. While it is believed the results of the test boring accurately indicate the existing soil conditions below the surface at points and planes indicated, the Owner, the Architect, and Engineer assume no responsibility for the actual conditions which may be encountered in the execution of the contract.
4. Additional test borings and other exploratory operations may be made by Bidder or Contractor at no cost to Owner.

1.3 WARRANTY

- A. Neither the Owner, the Architect, or the Engineer, represent, warrant or guarantee that the materials actually encountered in the prosecution of the work, or any part thereof, will be of the same character as those indicated by the sample or logs of the test borings, and if the Contractor relies, for any purpose, upon the accuracy or completeness of said borings or log information, he does so at his own risk.

1.4 ATTACHMENTS

- A. Soils Report Titled "Report of Subsurface Exploration and Geotechnical Consulting Services" dated July 5, 2024, prepared by John D. Hynes & Associates, Inc..

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 02 32 00



JOHN D. HYNES & ASSOCIATES, INC.

*Geotechnical and Environmental Consultants
Monitoring Well Installation
Construction Inspection and Materials Testing*

July 5, 2024

Danielle Peters, AIA
GWWO Architects
800 Wyman Park Drive, Suite 300
Baltimore, Maryland 21211

Re: Report of Subsurface Exploration and Geotechnical
Consulting Services
Fort Miles Museum Addition
Lewes, Delaware
Project No.: JDH-10/23/342

Dear Ms. Peters:

John D. Hynes & Associates, Inc. has completed the authorized subsurface exploration and geotechnical consulting services for the Fort Miles Museum Addition project located on Post Lane in Lewes, Delaware. Our services were performed, generally, in accordance with our proposal dated July 24, 2023.

This report describes the exploration methods employed, exhibits the data obtained, and presents our evaluations and recommendations. If the recommendations of the report regarding subgrade preparation and construction are followed, we recommend that the museum addition's foundation be designed using a maximum allowable soil bearing pressure of 2,000 psf. Refer to the Building Foundations section of this report for additional foundation recommendations.

We appreciate the opportunity to be of service to you. If you have any questions regarding the contents of this report or if we may be of further assistance, please contact our office.

Respectfully,
JOHN D. HYNES & ASSOCIATES, INC.

Evan H. Cross
Geologist

EHC: JDH/kjc

John D. Hynes, P.E.
President



**REPORT OF
SUBSURFACE EXPLORATION
AND
GEOTECHNICAL CONSULTING SERVICES**

**FORT MILES MUSEUM ADDITION
LEWES, DELAWARE**

**PREPARED FOR
GWWO ARCHITECTS**

**JULY 5, 2024
PROJECT NO.: JDH-10/23/342**



TABLE OF CONTENTS

PAGE

PURPOSE AND SCOPE	1
EXISTING SITE CONDITIONS	1
PROJECT CHARACTERISTICS	1
FIELD EXPLORATION AND STUDY	2
SUBSURFACE CONDITIONS	2
RECOMMENDATIONS	3
A. Site Preparation	3
B. Fill Selection, Placement and Compaction	4
C. Building Foundations	4
D. Floor Slab Support.....	5
E. Earth Pressure Requirements for Below Grade Walls	5
F. Groundwater and Drainage.....	6
ADDITIONAL SERVICES RECOMMENDED	6
A. Site Preparation and Proofrolling Monitoring.....	6
B. Fill Placement and Compaction Monitoring.....	7
C. Footing Excavation Inspections.....	7
REMARKS.....	7
APPENDIX	8



PURPOSE AND SCOPE

The subsurface exploration study was performed to evaluate the subsurface conditions with respect to the following:

1. General site and subgrade preparation;
2. Fill and backfill construction;
3. Foundation recommendations, including allowable bearing capacity, anticipated settlement, and embedment depths of building foundations;
4. Frost depth;
5. Floor slab support;
6. Earth pressure requirements for below grade walls;
7. Location of groundwater and applicable construction dewatering control procedures; and
8. Other aspects of the design and construction for the proposed structures indicated by the exploration.

An evaluation of the site, with respect to potential construction problems and recommendations dealing with earthwork and inspection during construction, is included. The inspection is considered necessary both to confirm the subsurface conditions and to verify that the soils related construction phases are performed properly.

EXISTING SITE CONDITIONS

As shown on the Project Location Map (Drawing JDH-10/23/342-A) in the Appendix, the project site is located at the underground bunker entrance on the west side of the bunker that currently houses the existing Fort Miles Museum on Battery Road in Lewes, Delaware. At the time of our exploration work, the site consisted of a concrete entranceway to an underground bunker associated with World War II era Artillery Battery No. 519 that has since been renovated and preserved as the Fort Miles Artillery Park. The bunker extends east to a former lookout structure that has since been converted to the Fort Miles Museum. The bunker continues beneath the sand dunes to the south where it leads to another lookout structure. The project location was limited to the western entrance to the underground bunker leading to the museum. The site is located on a large sand dune known as the Cape Henlopen Great Dune. The project site is bordered by the Fort Miles Artillery Park to the west, by sand dunes and scrub brush to the north and south, and by sand dunes and scrub brush to the east followed by the Atlantic Ocean. Topographically, the project site slopes upward to the top of the dune to the east then slopes downward towards the ocean. The project site slopes downward from the side of the sand dune to the west then slopes gently down the paved walkway. Elevations remain consistent along the wall and crest of the sand dune to the north and south. Existing elevations range from Elevation El. 56 at the toe of the sand dune to El. 74 at the top of the concrete bunker entrance. Elevations were provided by GWWO Architects.

PROJECT CHARACTERISTICS

The project includes a 2,400 sf addition to the Fort Miles Museum. As shown on the Building Layout Plan provided by GWWO Architects (JDH Drawing No.: 10/23/342-B-1) in the Appendix, the addition will include 8 single user bathrooms, a ticketing lobby, an exhibit area, an office, and a mechanical room. Based on discussions with GWWO Architects, the building addition will encompass approximately 2,400 s.f. and will consist of steel and concrete construction. GWWO Architects indicated that maximum column loads will be 24 kips and maximum wall loads will be 7.4 klf. The building will have a concrete slab on grade.



Hynes & Associates were, also, asked to locate a below grade concrete duct bank alignment located along the south wall line of the proposed addition.

FIELD EXPLORATION AND STUDY

In order to determine the nature of the subsurface conditions, 3 test borings, designated as B-1, B-2, and B-3, were drilled at or near the footprint of the proposed addition on June 11, 2024. The approximate boring locations are shown on the Boring Location Plan (Drawing No. JDH-10/23/342-B-2) in the Appendix. Structural borings B-1 and B-2 were drilled to depths of 25.5 feet below existing grade. Structural boring B-3 was drilled to a depth of 40.5 feet and was located near the top of the dune where the walls of the proposed structure will be the deepest below grade. The borings were drilled using a track-mounted Geoprobe 7822 drill rig.

Soil sampling and testing were carried out in accordance with ASTM Specification D-1586. A brief description of our field procedures is included in the Appendix. The results of all boring and sampling operations are shown on the boring logs.

Samples of the subsurface soils were examined by our engineering staff and were visually classified in accordance with the Unified Soil Classification System (USCS) and ASTM Specification D-2488. The estimated USCS symbols appear on the boring logs and keys to the systems' nomenclature are provided in the Appendix of this report. Also included are reference sheets that define the terms and symbols used on the boring logs and explain the Standard Penetration Test procedures.

We note that the test boring records represent our interpretation of the field data based on visual examination. Indicated interfaces between materials may be gradual.

The field exploration data was supplemented with laboratory testing data. The laboratory at John D. Hynes & Associates, Inc. performed 2 Sieve Analysis tests, and 2 Natural Moisture Content tests. The test results are presented on the borings logs in the Appendix.

SUBSURFACE CONDITIONS

At the time of our field exploration, "beach sand" (dune sand) was encountered at the ground surface at soil test borings B-1 and B-2 and approximately 1 inch of organic bearing soil was encountered at the ground surface at soil test boring location B-3. Varying thicknesses of sand, organic bearing soil or other surficial materials may be encountered at other locations on site.

The subsurface soils encountered were visually classified in accordance with the USCS as interbedded layers of low-silt SAND (SP, SP-SM) to the boring termination depths. The granular soil layers were characterized by Standard Penetration Test (SPT) values (N-values) ranging from 5 to 43 blows per foot indicating in-place relative densities of very loose to dense. Cohesive soil layers were not encountered to the boring termination depths.

Groundwater was not encountered during drilling operations to the boring terminations depths of 25.5 to 40.5 feet below existing grade. Groundwater elevations may vary at other times during the year depending upon the amount of local precipitation and the extent of local surface development.



The concrete duct bank along the proposed south wall line was located and measured. The top of the duct bank was 1 foot below grade where we measured the duct bank concrete. The duct bank was 8 feet wide in plan, and was 2.5 feet in depth (thickness). We include depths and measurements of the duct bank on our Boring Location Plan (JDH Drawing No.: 10/23/342-B-2) in the Appendix.

RECOMMENDATIONS

The following recommendations and considerations are based on our understanding of the proposed construction, the data obtained from the exploration, and our previous experience with similar subsurface conditions and projects. If there are any significant changes to the project characteristics, such as revised structural loadings differing significantly from those noted above, different building type, building geometry, building locations, elevations, etc., we request that this office be advised so the recommendations of this report can be re-evaluated.

A. Site Preparation

Prior to the construction of foundations, ground slabs, or the placement of fill in any structural areas, all existing organic materials, frozen or wet soils, excessively soft or loose soils, and other deleterious materials should be removed and wasted. If groundwater or perched surface water are encountered during any grading or excavation process, Hynes & Associates should be consulted for additional recommendations regarding the stabilization of the bases of the excavations and backfilling.

After the stripping operations have been completed, the exposed subgrade soils should be inspected. The inspector should verify that loose soils, organic matter debris, rubble, old foundations, abandoned utilities, and tree stumps have been removed from structural subgrade areas. The inspector may require the exposed subgrade materials be proofrolled utilizing a heavily-loaded dump truck or other pneumatic tired vehicle of similar size and weight. The purpose of proofrolling would be to provide surficial densification and to locate any isolated areas of soft or loose soils requiring undercutting. Proofrolling is not advised in wet areas which may deteriorate under repeated vehicular loading. Wet areas should be drained and allowed to dry prior to proofrolling. Precipitation may result in standing water (perched water) at low areas. If the water is allowed to pond, the natural soils may deteriorate and overexcavation or subgrade improvements may be necessary at those areas. The Geotechnical Engineer should be consulted to evaluate poor subgrade conditions during construction.

If trenches or excavations deeper than 4 feet are required for utilities or foundation elements, these should be sloped back at least to 1.5H:1V slope to prevent failure that can be experienced at vertical excavations. The contractor shall implement the requirements stipulated by OSHA for support of excavations, where required. Refer to OSHA 29 CFR Part 1926 for the requirements.

Care should be exercised during the grading operations at the site. Shallow low-Silt SAND (SP, SP-SM) materials were identified at the boring locations. These materials are slightly sensitive to changes in moisture. The site should be allowed to drain following precipitation. The site will drain quickly. The contractor should protect subgrades and fills during the earthwork operations. If subgrade problems arise, the Geotechnical Engineer should be consulted for an evaluation of the conditions. Overexcavated areas resulting from the removal of organic matter, tree stumps, debris, or otherwise unacceptable materials should be backfilled with properly compacted materials in accordance with the procedures discussed in the following section.



B. Fill Selection, Placement and Compaction

It is recommended that all materials to be used as structural fill, including the materials to be used in the construction of the embankment around the building, be inspected, tested and approved by the Geotechnical Engineer prior to use. The native SP and SP-SM soils that are at the appropriate moisture content and do not contain organics may be re-used for structural fill. Acceptable borrow material should include GW, SM, SW and SP classified in accordance with the USCS. Furthermore, the material to be utilized as structural fill should have a Plasticity Index (PI) less than 20.

The importation of high quality, granular material should be allowed, and acceptable unit rates for importation and placement should be established. Sand, gravel or sand/gravel mixtures would be appropriate for wet weather placement. Otherwise, the materials noted above will be acceptable for use as structural fill. Imported SM soils will be sensitive to alteration in moisture content and will become unworkable during and following periods of precipitation. For this reason, if earthwork is attempted in late autumn, winter or early spring, the above mentioned high quality imported granular material should be limited to those soils better than SM. SM materials become unworkable at moisture contents greater than 3 percentage points above optimum. The contractor would have to dry these SM materials or set them aside for use in landscaping areas.

Structural fill should be placed in lifts which are 8 inches or less in loose thickness and should be compacted to at least 95 percent of the Modified Proctor maximum dry density (ASTM D-1557). Adjustments to the natural moisture content of the soils may be required in order to obtain specified compaction levels. Should utility construction be performed after earthwork, the Contractor should be responsible for achieving 95 percent compaction in all trench backfill. These guidelines should be set for all structural fill at the site including, but not limited to building, ground slab and pavement fills.

For the proofrolling and fill compaction operations, fill limits should be extended at least 10 feet beyond the structure exterior walls, exterior columns, and ground slab boundaries. A sufficient number of in-place density tests should be performed by an engineering technician to verify that the proper degree of compaction is being obtained in all fill soils.

C. Building Foundations

GWWO Architects indicated that the new building addition will encompass approximately 2,400 sf and will consist of steel and concrete construction. GWWO indicated that maximum column loads will be 24 kips and maximum wall loads will be 7.4 klf.

Considering current and proposed grade levels, the in-situ soil conditions and the provided structural loadings, we recommend that the addition building's structural elements be supported on spread footing foundations bearing on firm, natural soils or controlled, structural fill. Footings supporting structural elements for the building's walls may be proportioned based upon a maximum allowable soil bearing pressure not in excess of 2,000 psf. Using this bearing pressure, we estimate total settlements of ½ inch or less. Differential settlement of ½ inch or less is expected.

Some locations may be encountered where less than the required bearing is available. Note that we encountered very loose sand in Boring B-3 at the approximate foundation subgrade, Elevation 51 to 55. The inspecting engineer may recommend overexcavating very loose soils, or compacting them in place in consideration of the depth of the very loose soils. For this reason, the inspection of the foundation excavations by the Geotechnical



Engineer is advised. The purpose of the inspection would be to verify that the exposed bearing materials are acceptable for the design soil bearing pressure and that loose, wet, frozen or compressible soils are not present.

Minimum dimensions of 30 inches for square footings and 24 inches for continuous or rectangular footings should be used in foundation design to minimize the possibility of a local shear failure. All foundation excavations should be inspected by the Geotechnical Engineer or his approved representative prior to the placement of concrete. The purpose of the inspection would be to verify that the exposed bearing materials are acceptable for the design soil bearing pressure and that loose, wet, frozen or compressible soils are not present.

Where continuous wall footings may need to be raised or lowered in elevation in a direction away from and perpendicular to other footings, footings may be gradually changed to the desired elevation using step construction procedures with a 2H:1 V, or more gentle, slope. In addition, discrete column, pier or wall footings bearing at a higher elevation than lower footings should be located at a distance apart which is equal to or greater than the difference in the elevations of the footings.

In Lewes, exterior footings and footings in unheated areas should be located at a depth of at least 24 inches to bottom of footing below the outside final grade to provide adequate frost cover protection. Foundations are expected to be 18 feet or more below final grade in the bank of the sand dune near soil test boring B-3 and must be at least 24 inches below grade near soil test borings B-1 and B-2. If the structure is to be constructed during the winter months or if the structures will be subjected to freezing temperatures after footing construction, then all footings should be adequately protected during freezing periods.

Soils exposed at the bases of all satisfactory foundation excavations should be protected against any detrimental change in condition, such as disturbance from rain or frost. Surface runoff should be drained away from the excavations and not be allowed to pond. Foundation excavations should be adequately protected from rainfall or freezing conditions.

D. Floor Slab Support

Ground supported building slabs may be supported on firm, natural soils or on a layer of controlled, structural fill. The subgrade should be prepared in accordance with the procedures described in Sections A and B of this report. It is, also, recommended that a 4 to 6 inch clean, granular, leveling and load-distributing material such as washed gravel, or screened crushed stone, be used beneath the floor slabs. This material will require acquisition from off-site sources. Prior to placing the leveling and load distributing material, the slab subgrade should be free of standing water or mud. An acceptable moisture barrier should, also, be provided for the building slab. These procedures will help to prevent capillary rise and damp floor slab conditions. For native soil or fill material placed and compacted according to the procedures outlined in this report, we recommend using a value of modulus of subgrade reaction of 150 pounds per cubic inch (pci).

E. Earth Pressure Requirements for Below Grade Walls

We recommend that all materials to be used as fill and backfill be inspected, tested and approved by the Geotechnical Engineer prior to use. Materials acceptable for retaining wall backfill include SP and SP-SM classified in accordance with USCS.



For below grade walls, it is recommended that retaining walls subject to lateral earth pressure be designed to resist an equivalent fluid weight of 63 pcf, provided that the backfill meets the requirements specified in this report. The following values should be used in the design:

Total Unit Weight (pcf)	Friction Angle	K_0	K_A	K_P	Coefficient of Sliding Friction
125	30°	0.5	0.33	3	0.45

The below grade walls should be designed to support surcharge loads from all anticipated structures adjacent to the walls. A lateral surcharge loading should, also, be applied in wall designs to account for all construction and future traffic loading to be applied adjacent to the wall. We recommend that a wall drainage system be installed in the wall. A drainage tile or other drainage layer should be placed near the bottom of the wall above or adjacent to the footing. Please see sketch (Drawing No. JDH-10/23/342-C) in the Appendix for loading parameters for the drained condition. If the walls are waterproofed, then it is our opinion that the draitile may be eliminated because of the well draining soils at the site.

The compaction behind these walls should be 92 to 95 percent of the Modified Proctor maximum dry density. Since excessive compaction may cause yielding or damage to foundation and retaining walls, hand operated equipment should be used near the walls.

Distribute passive pressure in a triangular load diagram with a bottom ordinate of $3\gamma d$, where γ = soil weight (buoyant if applicable) and d = depth of bottom of wall below top of resisting soil. A factor of safety of 1.5 is recommended.

F. Groundwater and Drainage

Groundwater was not encountered during drilling operations to the boring termination depths of 25.5 to 40.5 feet below existing grade at the boring locations. Groundwater elevations may vary at other times during the year depending upon the amount of local precipitation and the extent of local surface development. Considering the proposed construction, the contractor will not experience foundation construction problems relating to the groundwater. The Contractor should be prepared to dewater the lowest excavations in the event of the infiltration of precipitation. If required, acceptable measures for dewatering should be implemented. These methods may include sumping and pumping, etc. Otherwise, the contractor should wait for the stormwater to infiltrate and/or drain. Adequate drainage should be provided at the site to minimize any increase in moisture content of the foundation subgrade soils. All ground slabs and site grades should be sloped away from the building to prevent ponding of water around it. The final site drainage should, also, be designed such that run-off onto adjacent properties is controlled properly.

ADDITIONAL SERVICES RECOMMENDED

Additional engineering, testing and consulting services recommended for this project are summarized below.

A. Site Preparation and Proofrolling Monitoring

The Geotechnical Engineer or experienced soils inspector should inspect the site after it has been stripped and excavated. The inspector should determine if any undercutting or in-place densification is necessary to prepare a



subgrade for fill placement, or slab and pavement support. The inspector should verify that organic soils, organic matter, tree stumps, and debris have been removed from all structural subgrade areas prior to filling operations.

B. Fill Placement and Compaction Monitoring

The Geotechnical Engineer or experienced soils inspector should witness all fill operations and take sufficient in-place density tests to verify that the specified degree of fill compaction is achieved. The inspector should observe and approve borrow materials used and should determine if their existing moisture contents are acceptable.

C. Footing Excavation Inspections

The Geotechnical Engineer should inspect all foundation excavations for the building. He should verify that the design bearing pressures are available and that no loose or soft areas exist beneath the bearing surfaces of the foundation excavations.

REMARKS

This report has been prepared solely and exclusively for GWWO Architects to provide guidance to design professionals in developing facilities plans for the proposed Fort Miles Museum Addition project located in Lewes, Delaware. It has not been developed to meet the needs of others, and application of this report for other than its intended purpose could result in substantial difficulties. The Consulting Engineer cannot be held accountable for any problems which occur due to the application of this report to other than its intended purpose. This report in its entirety should be attached to the project specifications.

These analyses and recommendations are, of necessity, based on the concepts made available to us at the time of the writing of this report, and on-site conditions, surface and subsurface that existed at the time the exploratory borings were drilled. Further assumption has been made that the limited exploratory borings, in relation both to the areal extent of the site and to depth, are representative of conditions across the site. It is, also, recommended that we be given the opportunity to review all plans for the project in order to comment on the interaction of soil conditions as described herein and the design requirements.

Our professional services have been performed, our findings obtained and our recommendations prepared in accordance with generally accepted engineering principles and practices.



APPENDIX

1. Investigative Procedures
2. Project Location Map
3. Building Layout Plan
4. Boring Location Plan
5. Boring Logs
6. Earth Pressure Requirements for Below Grade Walls (Drained)
7. Unified Soil Classification Sheet
8. Field Classification Sheet
9. Important Information Sheet



INVESTIGATIVE PROCEDURES

SOIL TEST BORINGS

Soil drilling and sampling operations were conducted in accordance with ASTM Specification D-1586. The borings were advanced by mechanically turning continuous hollow stem auger flights into the ground. At regular intervals, samples were obtained with a standard 1.4 inch I.D., 2.0 inch O.D. split-spoon sampler. The sampler was first seated 6 inches to penetrate any loose cuttings and then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot is the "Standard Penetration Resistance". The penetration resistance, when properly evaluated, is an index to the soil's strength, density and behavior under applied loads. The soil descriptions and penetration resistances for each boring are presented on the Test Boring Records in the Appendix.

SOIL CLASSIFICATION

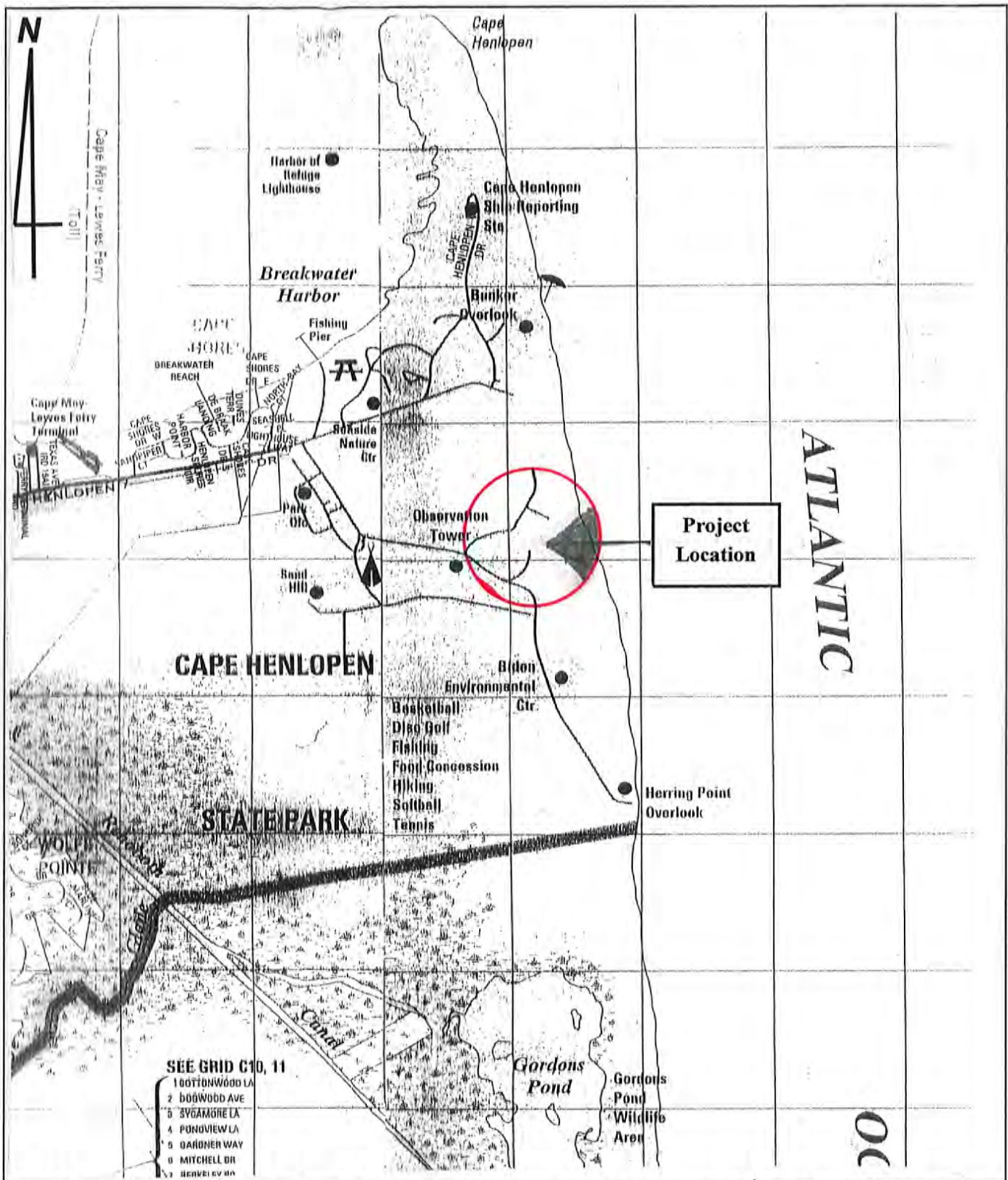
Soil classifications provide a general guide to the engineering properties of various soil types and enable the engineer to apply his past experience to current problems. In our investigation, jar samples obtained during drilling operations are examined in our laboratory and visually classified by the geotechnical engineer in accordance with ASTM Specification D-2488. The soils are classified according to the AASHTO or Unified Classification System (ASTM D-2487). Each of these classification systems and the in-place physical soil properties provides an index for estimating the soil's behavior.

NATURAL MOISTURE TEST

Portions from representative soil samples obtained during drilling operations were selected for Natural Moisture Content testing. The Natural Moisture Content Test determines the moisture content of soils by drying the sample in an oven with a standard drying temperature of 110 °C. The loss of mass drying the sample, is used to determine the moisture content into the soil. The natural moisture content of the sample is calculated in percentage as the weight of water divided by the weight of dry soil times 100. The natural moisture content of soils is determined in accordance with ASTM Specification D-2216.

SIEVE ANALYSIS TEST

Gradational analysis tests were performed to determine the particle size and distribution of the samples tested. The grain size distribution of soils coarser than a No. 200 sieve is determined by passing the sample through a standard set of nested sieves. The percentage of materials passing the No. 200 sieve is determined by washing the material over a No. 200 sieve. These tests are in accordance with ASTM D-421, D-422 and D-1140. The results are presented in the Appendix to our report.



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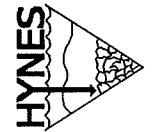
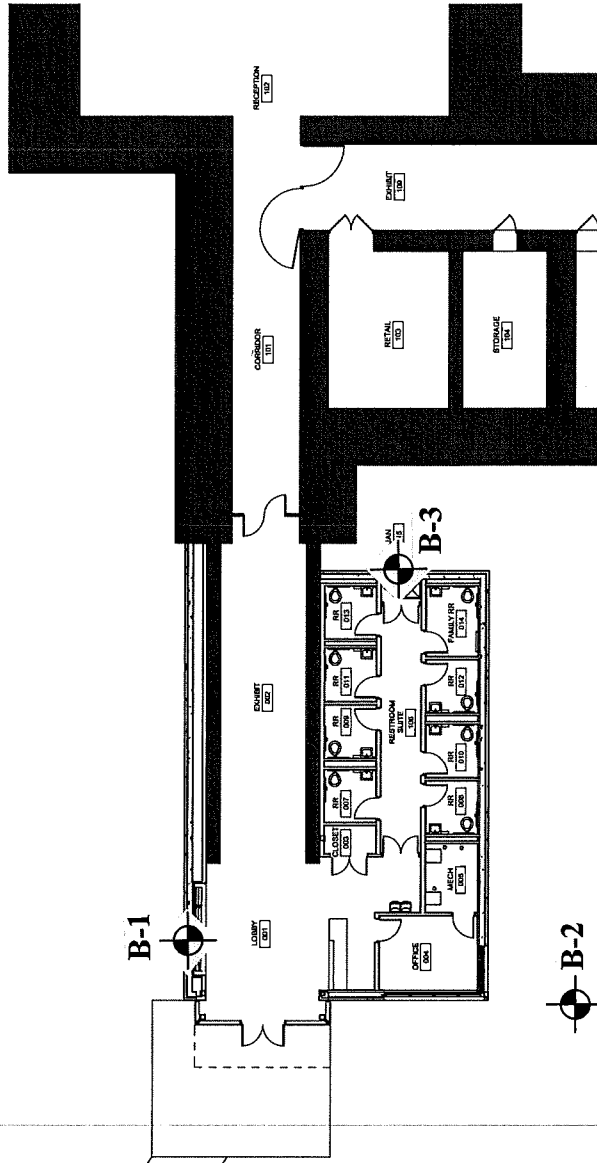
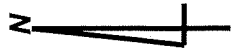
Date: June 17, 2024

Scale: 1 in. ≈ 2,000 ft.

Drawn: ADC Map

Project Location Map
Fort Miles Museum Addition
Lewes, Delaware

DWG. No.
JDH-10/23/342-A



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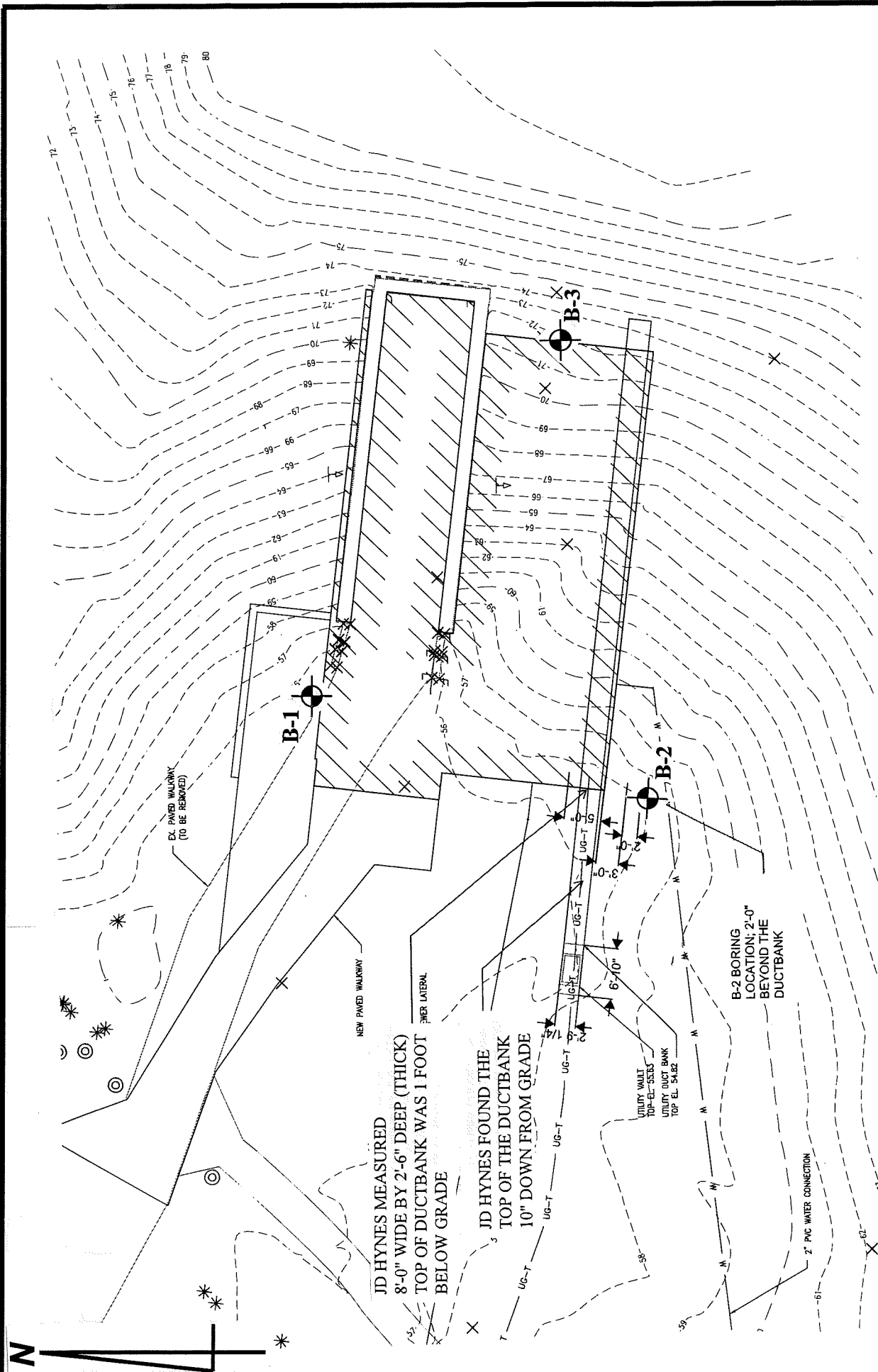
Building Layout Plan
Fort Miles Museum Addition
Lewes, Delaware

Date: July 3, 2024

Scale: NTS

Drawn: GWVO

DWG. No. JDH-10/23/342-B-1



HYNES	JOHN D. HYNES & ASSOCIATES, INC.	Boring Location Plan	Date: July 3, 2024
32185 Beaver Run Drive • Salisbury, Maryland 21804	Fort Miles Museum Addition	Scale: NTS	Scale: NTS
410-546-6462 / Fax: 410-548-5346	Lewes, Delaware	Drawn: GWVO	Drawn: GWVO
		DWG. No. JDH-10/23/342-B-2	DWG. No. JDH-10/23/342-B-2



**HYNES
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LOG OF BORING B-1

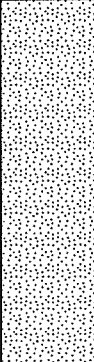
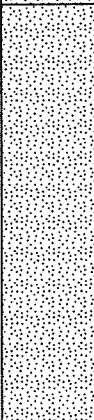
(Page 1 of 1)

GWWO Architects
1215 E. Fort Avenue, Liberty Bldg., Suite 24
Baltimore, Maryland 21230

Fort Miles Museum Addition

Project No.: JDH-10/23/342

Date Completed: : June 11, 2024
Logged By: : A. Garkushin
Drilled By: : B. Hynes
Drilling Method: : HSA (Geoprobe 7822 DT)
Total Depth: : 25.5 feet

Depth in Feet	Surf. Elev. 56	DESCRIPTION	GRAPHIC	USCS	Sample	Blow Count	REMARKS											
0	56	Light brown, wet, loose to medium dense, fine to medium SAND, with trace silt		SP	1	2-3-4	Scale 1" ~ 6.2 feet											
2	54				2	3-6-7	No organic bearing soil was encountered at the ground surface.											
4	52				3	5-7-10	Groundwater was not encountered during drilling operations.											
6	50				4	6-9-11	Boring caved in at 4 feet.											
8	48	Light brown, wet, medium dense to dense, fine to medium SAND, with trace silt		SP	5	9-15-21	Laboratory Test Results											
10	46				6	6-11-17	Sample No. 2 From 3 to 4.5 feet											
12	44				7	9-14-20	Sieve Analysis											
14	42						<table><tr><td>Sieve Size</td><td>Passing %</td></tr><tr><td>No. 10</td><td>100</td></tr><tr><td>No. 20</td><td>97.9</td></tr><tr><td>No. 40</td><td>48.0</td></tr><tr><td>No. 60</td><td>10.0</td></tr><tr><td>No. 100</td><td>1.4</td></tr><tr><td>No. 200</td><td>0.5</td></tr></table>	Sieve Size	Passing %	No. 10	100	No. 20	97.9	No. 40	48.0	No. 60	10.0	No. 100
Sieve Size	Passing %																	
No. 10	100																	
No. 20	97.9																	
No. 40	48.0																	
No. 60	10.0																	
No. 100	1.4																	
No. 200	0.5																	
16	40	Boring terminated at 25.5 feet.					Natural Moisture = 3.9%											
18	38																	
20	36																	
22	34																	
24	32																	
26	30																	
28	28																	
30	26																	
32	24																	
34	22																	
36	20																	
38	18																	
40	16																	
42																		



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LOG OF BORING B-2

(Page 1 of 1)

GWWO Architects
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Baltimore, Maryland 21230

Fort Miles Museum Addition

Project No.: JDH-10/23/342

Date Completed: : June 11, 2024
Logged By: : A. Garkushin
Drilled By: : B. Hynes
Drilling Method: : HSA (Geoprobe 7822 DT)
Total Depth: : 25.5 feet

Project No. SD-10-20-012							
Depth in Feet	Surf. Elev. 57	DESCRIPTION	GRAPHIC	USCS	Sample	Blow Count	REMARKS
0 - 57		Brown, wet, loose, fine to medium SAND, with trace silt, trace gravel		SP	1	3-4-5	Scale 1" ~ 6.2 feet
2 - 55		Light brown, wet, medium dense to dense, fine to medium SAND, with trace silt		SP	2	3-5-7	No organic bearing soil was encountered at the ground surface.
4 - 53					3	4-6-9	Groundwater was not encountered during drilling operations.
6 - 51					4	6-12-16	Boring caved in at 4.5 feet.
8 - 49					5	7-14-19	Laboratory Test Results
10 - 47					6	3-8-12	Sample No. 7 From 24 to 25.5 feet
12 - 45					7	6-13-20	Natural Moisture = 6.0%
14 - 43		Boring terminated at 25.5 feet.					
16 - 41							
18 - 39							
20 - 37							
22 - 35							
24 - 33							
26 - 31							
28 - 29							
30 - 27							
32 - 25							
34 - 23							
36 - 21							
38 - 19							
40 - 17							
42 -							



**HYNES
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LOG OF BORING B-3

(Page 1 of 1)

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Baltimore, Maryland 21230

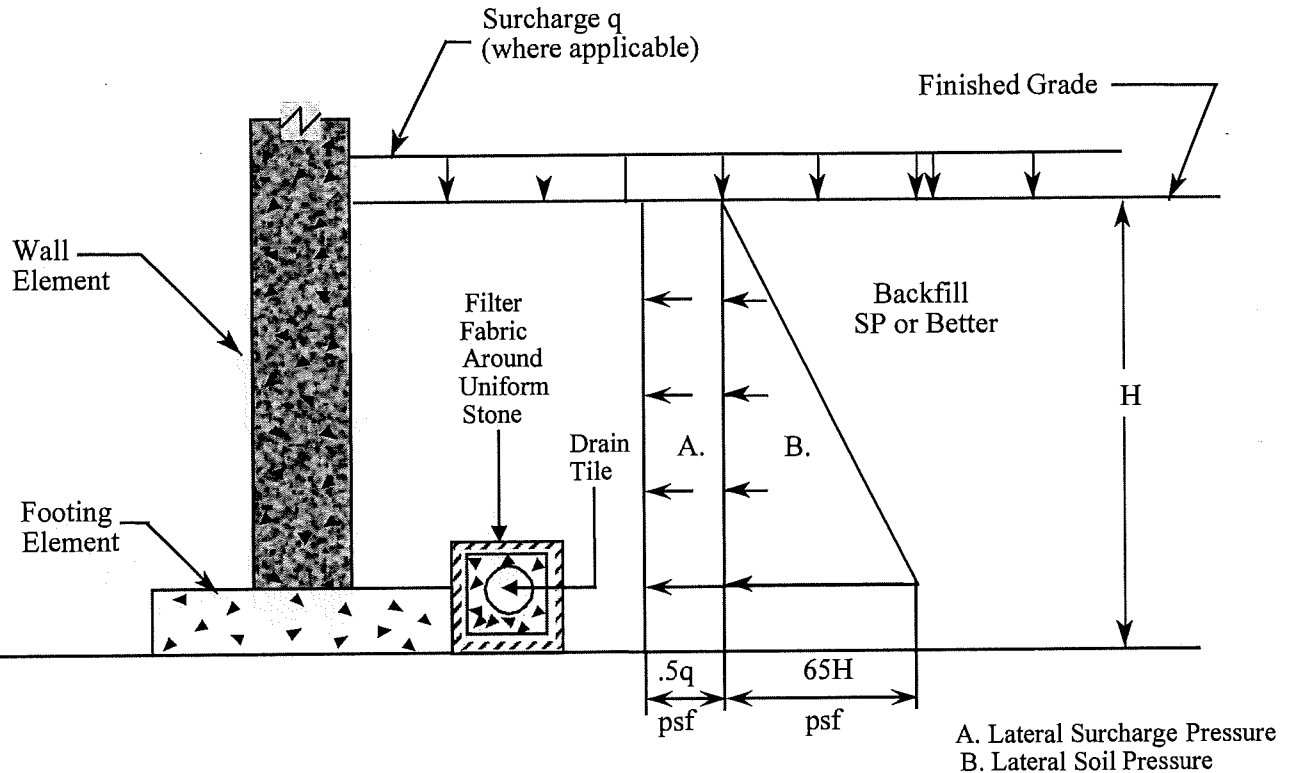
Fort Miles Museum Addition

Project No.: JDH-10/23/342

Date Completed: : June 11, 2024
Logged By: : A. Garkushin
Drilled By: : B. Hynes
Drilling Method: : HSA (Geoprobe 7822 DT)
Total Depth: : 25.5 feet

Depth in Feet	Surf. Elev. 72	DESCRIPTION	GRAPHIC	USCS	Sample	Blow Count	REMARKS
0	72	Brown to light brown, wet, very loose to loose, fine to medium SAND, with trace silt, trace gravel		SP	1	1-2-3	Scale 1" ~ 6.2 feet
2	70				2	3-3-3	Approximately 1 inch of organic bearing soil was encountered at the ground surface.
4	68						Groundwater was not encountered during drilling operations.
6	66						Boring caved in at 4 feet.
8	64						
10	62	loose brown, wet, loose to medium dense, fine to medium SAND, with trace silt		SP	3	3-6-7	Laboratory Test Results
12	60				4	2-3-3	Sample No. 6 From 21 to 22.5 feet
14	58						Sieve Analysis
16	56						Sieve Size Passing %
18	54	Light brown, wet, very loose, fine to medium SAND, with trace silt		SP	5	1-2-2	3/4" 100 1/2" 93.4 3/8" 92.2 No. 4 85.5 No. 10 79.7 No. 20 67.9 No. 40 40.5 No. 60 20.0 No. 100 11.7 No. 200 8.1
20	52				6	3-5-8	
22	50	Light brown, wet, medium dense, fine to medium SAND, with trace to little silt, trace gravel		SP-SM			
24	48	Light brown, wet, medium dense to dense, fine to medium SAND, with trace silt			7	6-13-17	Natural Moisture = 8.2%
26	46						
28	44						Sample No. 10 From 39 to 40.5 feet
30	42				8	7-14-18	Natural Moisture = 4.1%
32	40						
34	38				9	7-16-23	
36	36						
38	34						
40	32				10	8-18-25	
42		Boring terminated at 40.5 feet.					

EARTH PRESSURE REQUIREMENTS FOR BELOW GRADE WALLS (DRAINED)



1. Pressure diagram assumes at rest soil pressures on cantilevered walls or walls with one support level.
2. Pressure diagram includes only loads resulting from backfill and surcharges.
3. This distribution assumes perimeter sub-drainage will be provided; therefore, hydrostatic pressure is not included.
4. For backfill, use SP or better quality material (ASTM D-2487).
5. Compact backfill in maximum 8-inch loose lifts to 92 to 95 percent maximum dry density (ASTM D-1557).
6. Use only light-duty hand operated compaction equipment within 10 feet of walls.
7. For surcharge q , consider the greater of the maximum expected construction equipment live loads or permanent structure dead and live loads.
8. For temporary retaining walls used for excavation support, use $2/3$ of the above values for lateral surcharge and soil pressures. This reflects the active soil pressure condition.



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Date: July 5, 2024

Scale: Not to Scale

DRAWN: JDH

Earth Pressure Requirements for Below Grade Walls (Drained)
Fort Miles Museum Addition
Lewes, Delaware

DWG. No.

JDH-10/23/342-C

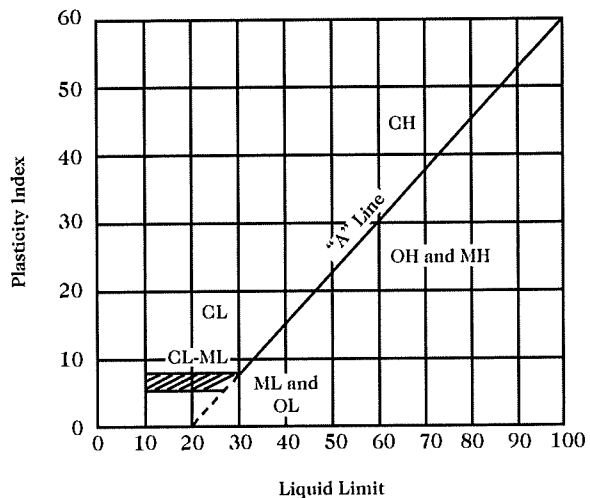


JOHN D. HYNES & ASSOCIATES, INC.

Geotechnical and Environmental Consultants
Monitoring Well Installation
Construction Inspection and Materials Testing

UNIFIED SOIL CLASSIFICATION SYSTEM

Major Divisions			Group Symbols		Typical Names		Laboratory Classification Criteria					
Coarse-grained soils (More than half of material is larger than No 200 sieve size)	Gravels (More than half of coarse fraction is larger than No 4 sieve size)	Clean gravels (Little or no fines)	GW		Well-graded gravels, gravel-sand mixtures, little or no fines		Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No 200 sieve size), coarse grained soils are classified as follows: Less than 5 percent More than 12 percent 5 to 12 percent GW, GP, SW, SP GM, GC, SM, SC Borderline cases requiring dual symbols ^a	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3				
			GP		Poorly graded gravels, gravel sand mixtures, little or no fines			Not meeting all gradation requirements for GW				
		Gravels with fines (Appreciable amount of fines)	GM ^a u	d	Silty gravels, gravel-sand-silt mixtures			Atterberg limits below "A" line or P.I. less than 4		Above "A" line with P.I. between 4 and 7 are <i>border-line</i> cases requiring use of dual symbols		
				GC	Clayey gravels, gravel-sand-clay mixtures			Atterberg limits above "A" line with P.I. greater than 7				
	Sands (More than half of coarse fraction is smaller than No 4 sieve size)	Clean sands (Little or no fines)	SW		Well-graded sands, gravelly sands,			$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3				
			SP		Poorly graded sands, gravelly sands, little or no fines			Not meeting all gradation requirements for SW				
		Sands with fines (Appreciable amount of fines)	SM ^a u	d	Silty sands, sand-silt mixtures			Atterberg limits below "A" line or P.I. less than 4		Above "A" line with P.I. between 4 and 7 are <i>border-line</i> cases requiring use of dual symbols.		
				SC	Clayey sands, sand-clay mixtures			Atterberg limits above "A" line with P.I. greater than 7				
		Fine-grained soils (More than half material is smaller than No 200 sieve)	Silts and clays (Liquid limit less than 50)	ML		Inorganic silts and very fine sands, rock flour, 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 sandy or silty soils, elastic silts									
	CH		Inorganic clays of high plasticity, fat clays									
	OH		Organic clays of medium to high plasticity, organic silts									
Highly organic soils	Pt		Peat and other highly organic soils									





FIELD CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

NON-COHESIVE SOILS

(Silt, Sand, Gravel and Combinations)

DENSITY

Very Loose	- 5 blows/ft. or less
Loose	- 6 to 10 blows/ft.
Medium Dense	- 11 to 30 blows/ft.
Dense	- 31 to 50 blows/ft.
Very Dense	- 51 blows/ft. or more

RELATIVE PROPORTIONS

Descriptive Term	Percent
Trace	1 - 10
Little	11 - 20
Some	21 - 35
And	36 - 50

PARTICLE SIZE IDENTIFICATION

Boulders	- 8 inch diameter or more
Cobbles	- 3 to 8 inch diameter
Gravel	- Coarse - 1 to 3 inch - Medium - 1/2 to 1 inch - Fine - 4.75 mm to 1/2 inch
Sand	- Coarse - 2.0 mm to 4.75 mm - Medium - 0.425 mm to 2.0 mm - Fine - 0.075 mm to 0.425 mm
Silt	- 0.075 mm to 0.002 mm

COHESIVE SOILS

(Clay, Silt and Combinations)

CONSISTENCY

Very Soft	- 3 blows/ft. or less
Soft	- 4 to 5 blows/ft.
Medium Stiff	- 6 to 10 blows/ft.
Stiff	- 11 to 15 blows/ft.
Very Stiff	- 16 to 30 blows/ft.
Hard	- 31 blows/ft. or more

PLASTICITY

Degree of Plasticity	Plasticity Index
None to Slight	0 - 4
Slight	5 - 7
Medium	8 - 22
High to Very High	over 22

Classification on logs are made by visual inspection of samples unless a sample has been subjected to laboratory classification testing.

Standard Penetration Test - Driving a 2.0" O.D., 1-3/8" I.D., splitspoon sampler a distance of 1.0 foot into undisturbed soil with a 140 pound hammer free falling a distance of 30.0 inches. It is customary to drive the spoon 6 inches to seat into undisturbed soil, then perform the test. The number of hammer blows for seating the spoon and making the test are recorded for each 6 inches of penetration on the drill log (Example - 6/8/9). The standard penetration test value (N - value) can be obtained by adding the last two figures (i.e. 8 + 9 = 17 blows/ft.). (ASTM D-1586)

Strata Changes - In the column "Soil Descriptions," on the drill log, the horizontal lines represent strata changes. A solid line (—) represents an actually observed change, a dashed line (----) represents an estimated change.

Groundwater - Observations were made at the times indicated. Porosity of soil strata, weather conditions, site topography, etc. may cause changes in the water levels indicated on the logs.

Important Information about This Geotechnical-Engineering Report

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

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

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

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer

will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

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

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

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept*

responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.

Most of the “Findings” Related in This Report Are Professional Opinions

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

This Report’s Recommendations Are Confirmation-Dependent

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

This Report Could Be Misinterpreted

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

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals’ plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

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

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note*

conspicuously that you’ve included the material for information purposes only. To avoid misunderstanding, you may also want to note that “informational purposes” means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled “limitations,” many of these provisions indicate where geotechnical engineers’ responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a “phase-one” or “phase-two” environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer’s services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, *proper implementation of the geotechnical engineer’s recommendations will not of itself be sufficient to prevent moisture infiltration.* Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. *Geotechnical engineers are not building-envelope or mold specialists.*



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SECTION 02 41 00 - SELECTIVE DEMOLITION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Selective demolition of built site elements.
- B. Selective demolition of building elements for alteration purposes.
- C. Salvage of existing items to be reused or recycled.

1.2 DEFINITIONS

- A. Existing to Remain: Existing items that are not to be removed or dismantled, except to the degree indicated for performing required Work.
- B. Remove: To detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- C. Remove and Reinstall: To detach items from existing construction in a manner to prevent damage, to prepare for reuse, and to reinstall where indicated.
- D. Retain: To keep and protect from damage existing items that are not to be removed or dismantled.
- E. Salvage: To protect removed or dismantled items from damage and to deliver them to Owner ready for reuse.

1.3 REFERENCE STANDARDS

- A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards.
- B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.5 SUBMITTALS

- A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for dust control and noise control, and for environmental protection. Indicate proposed locations and construction of barriers.
- B. Demolition Plan: Submit demolition plan as specified by OSHA and local authorities.
 - 1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences.
- C. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Submit before Work begins.
- D. Project Record Documents:
 - 1. Record Drawings: Accurately record actual locations of capped and active utilities and subsurface construction.
 - 2. Inventory: Submit a list of items that have been removed and salvaged.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with notification regulations of authorities having jurisdiction before beginning removal and dismantling work. Comply with hauling and disposal regulations of authorities having jurisdiction.

1.7 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
 - 1. Before selective demolition, Owner will remove the following items:
 - a. Low bollard lighting along entrance path.
 - b. Low bollard lighting along construction path (as designated on AS.1)

- c. Doors into the exhibit spaces.
 - d. Wooden door in the main corridor at the south end of Battery 519.
- C. Notify Architect and Owner of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials:
 - 1. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCBs, and mercury.
 - 2. If PCBS or asbestos are encountered, these materials will be removed by the Owner.
 - 3. If lead paint is encountered, it will be removed by Contractor .
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.1 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.
 - 2. Comply with applicable requirements of NFPA 241.
 - 3. Use of explosives is not permitted.
 - 4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.

5. Provide, erect, and maintain temporary barriers and security devices.
 6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
 7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 8. Do not close or obstruct roadways or sidewalks without permit.
 9. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
 10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
- B. Do not begin removal until receipt of notification to proceed from Owner.
- C. Do not begin removal until built elements to be salvaged or relocated have been removed.
- D. Do not begin removal until vegetation to be relocated has been removed and vegetation to remain has been protected from damage.
- E. Protect existing structures and other elements that are not to be removed.
1. Provide bracing and shoring.
 2. Prevent movement or settlement of adjacent structures.
 3. Stop work immediately if adjacent structures appear to be in danger.
- F. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- G. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.
- H. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.

1. Comply with requirements specified in Section 01 3233 "Photographic Documentation."
2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.

3.2 EXISTING UTILITIES

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 7 days prior written notification to Owner.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.
- H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.

3.3 SELECTIVE DEMOLITION, GENERAL

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 1. Verify construction and utility arrangements are as indicated.
 2. Report discrepancies to Architect before disturbing existing installation.

3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Separate areas in which demolition is being conducted from areas that remain occupied.
 1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 50 00 in locations indicated on drawings.
- C. Remove existing work as indicated and as required to accomplish new work.
 1. Remove items indicated on drawings.
- D. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 3. Verify that abandoned services serve only abandoned facilities before removal.
 4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
- E. Selective Demolition Procedures: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 3. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

F. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area on-site designated by Owner.
5. Protect items from damage during transport and storage.

G. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

H. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

I. Protection:

1. Temporary Shoring:
 - a. Prevent movement of structure; provide shoring and bracing if necessary.
 - b. Design, provide, and maintain shoring, bracing and structural supports as required to preserve stability and prevent movement, settlement or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
2. Remove temporary barricades and protections where hazards no longer exist.

3.4 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

3.5 DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site.
- B. Remove from site all materials not to be reused on site; comply with requirements of Section 01 74 19 - Waste Management.
- C. Leave site in clean condition, ready for subsequent work.
- D. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION 02 41 00

SECTION 03 01 00 - MAINTENANCE OF CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cleaning of existing concrete surfaces.
- B. Repair of exposed structural, shrinkage, and settlement cracks.
- C. Resurfacing of concrete surfaces having spalled areas and other damage.
- D. Repair of deteriorated concrete.

1.2 PRICE AND PAYMENT PROCEDURES

- A. Repair Surface: By the square foot. Includes surface preparation, repair, finishing.

1.3 ABBREVIATIONS AND ACRONYMS

- A. CFRP: Carbon Fiber Reinforced Polymer.

1.4 DEFINITIONS

- A. Carbon Fiber Reinforced Polymer (CFRP): Composite material comprising a polymer matrix reinforced with carbon fiber cloth, mat, or strands.

1.5 SUBMITTALS

- A. Product Data: Indicate product standards, physical and chemical characteristics, technical specifications, limitations, maintenance instructions, and general recommendations regarding each material.
- B. Shop Drawings for Applied Composite Repairs: Provide shop drawings signed and sealed by Professional Engineer indicating:
 - 1. Repair location.
 - 2. Repair details.
 - 3. Fiber type, dimensions, number, thickness, and direction of layers.
 - 4. Installation sequence.

5. Splice details.
6. Joint and end details.
7. Anchorage.
8. Connections.

C. Cleaner's qualification statement.

1.6 QUALITY ASSURANCE

- A. Cleaner Qualifications: Company specializing in, and with minimum of 3 years of experience in, the type of cleaning specified.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturers' instructions for storage, shelf life limitations, and handling of products.

PART 2 PRODUCTS

2.1 CLEANING MATERIALS

- A. Detergent: Non-ionic detergent.

2.2 CEMENTITIOUS PATCHING AND REPAIR MATERIALS

- A. Manufacturers:

1. ARDEX Engineered Cements: www.ardexamericas.com/#sle.
2. The QUIKRETE Companies: www.quikrete.com/#sle.
3. W. R. Meadows, Inc: www.wrmeadows.com/#sle.

- B. Cementitious Resurfacing Mortar: One- or two-component, factory-mixed, polymer-modified cementitious mortar designed for continuous thin-coat vertical and horizontal application.

1. In-place material resistant to freeze/thaw conditions.
2. Mixed with water or latex type bonding agent in proportions as recommended by manufacturer.

3. Integral corrosion inhibitor.
4. Recommended Thickness: Feather edge to 1/8 inch.
5. Color: Gray.

2.3 ACCESSORIES

- A. Portland Cement: ASTM C150/C150M, Type I, grey.
- B. Sand: ASTM C33/C33M or ASTM C404; uniformly graded, clean.
- C. Water: Clean and potable.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are ready to receive work.
- B. Beginning of installation means acceptance of substrate.

3.2 PREPARATION

- A. Prepare concrete surfaces to be repaired according to ICRI 310.2R.

3.3 CLEANING EXISTING CONCRETE

- A. Provide enclosures, barricades, and other temporary construction as required to protect adjacent work from damage.
- B. Clean concrete surfaces of dirt or other contamination using the gentlest method that is effective.
 1. Try the gentlest method first, then, if not clean enough, use a less gentle method taking care to watch for impending damage.
 2. Clean out cracks and voids using same methods.
- C. The following are acceptable cleaning methods, in order from gentlest to less gentle:
 1. Water washing using low-pressure, maximum of 100 psi, and, if necessary, brushes with natural or synthetic bristles.

2. Increasing the water washing pressure to maximum of 400 psi.
 3. Adding detergent to washing water; with final water rinse to remove residual detergent.
 4. Steam-generated low-pressure hot-water washing.
- D. Do not use any of the following cleaning methods, unless otherwise indicated:
1. Brushes with wire bristles, grinding with abrasives, solvents, hydrochloric or muriatic acid, sodium hydroxide, caustic soda, or lye.
 2. Soap or detergent that is not non-ionic.

3.4 CONCRETE SURFACE REPAIR USING CEMENTITIOUS MATERIALS

- A. Clean concrete surfaces, cracks, and joints of dirt, laitance, corrosion, and other contamination using method(s) specified above and allow to dry.
- B. Follow bonding agent and repair mortar manufacturer's written installation instructions.
- C. Apply coating of bonding agent to entire concrete surface to be repaired.
- D. Fill voids with cementitious mortar flush with surface.
- E. Apply repair mortar by steel trowel to a minimum thickness of 1/4 inch over entire surface, terminating at a vertical change in plane on all sides.
- F. Trowel finish to match adjacent concrete surfaces.
- G. Damp cure for four days.

END OF SECTION 03 01 00

SECTION 03 20 00 – CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Steel reinforcement bars.
 - 2. Welded-wire reinforcement.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Each type of steel reinforcement.
 - 2. Bar supports.
 - 3. Mechanical splice couplers.
- B. Shop Drawings: Comply with ACI SP-066:
 - 1. Include placing drawings that detail fabrication, bending, and placement.
 - 2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.
- C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.
 - 1. Location of construction joints is subject to approval of Architect.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
 - 1. Reinforcement to Be Welded: Welding procedure specification in accordance with AWS D1.4/D1.4M.
- B. Material Certificates: For each of the following, signed by manufacturers:

1. Epoxy-Coated Reinforcement: CRSI's "Epoxy Coating Plant Certification."
 - C. Material Test Reports: For the following, from a qualified testing agency:
 1. Steel Reinforcement:
 - a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.
 2. Mechanical splice couplers.
 - D. Field quality-control reports.
 - E. Minutes of preinstallation conference.
- 1.5 QUALITY ASSURANCE
- A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60 (Grade 420) deformed.
- B. Low-Alloy Steel Reinforcing Bars: ASTM A706/A706M, deformed.
- C. Headed-Steel Reinforcing Bars: ASTM A970/A970M.
- D. Galvanized Reinforcing Bars:
 1. Steel Bars: ASTM A615/A615M, Grade 60 (Grade 420) deformed bars.
 2. Zinc Coating: ASTM A767/A767M, Class I zinc coated after fabrication and bending.
- E. Epoxy-Coated Reinforcing Bars:
 1. Steel Bars: ASTM A615/A615M, Grade 60 (Grade 420) deformed bars.
 2. Epoxy Coating: ASTM A775/A775M with less than 2 percent damaged coating in each 12-inch (305-mm) bar length.
- F. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.
- G. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

- H. Galvanized-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from galvanized-steel wire into flat sheets.
- I. Epoxy-Coated Welded-Wire Reinforcement: ASTM A884/A884M, Class A coated, Type 1, plain steel.

2.2 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.
 - 1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
 - b. For epoxy-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated wire bar supports.
 - c. For dual-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated wire bar supports.
 - d. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.
 - e. For stainless steel reinforcement, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
- B. Mechanical Splice Couplers: ACI 318 (ACI 318M) Type 1, same material of reinforcing bar being spliced; compression-only type, tension-compression type, dowel-bar type, or mechanical-lap type.
- C. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch (1.2908 mm) in diameter.
 - 1. Finish: Galvanized ASTM A884/A884M, Class A, Type 1, epoxy coated, with less than 2 percent damaged coating in each 12-inch (305-mm) wire length.
- D. Stainless Steel Tie Wire: ASTM A1022/A1022M, not less than 0.0508 inch (1.2908 mm) in diameter.

2.3 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protection of In-Place Conditions:
 - 1. Do not cut or puncture vapor retarder.
 - 2. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

- A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
- B. Accurately position, support, and secure reinforcement against displacement.
 - 1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
 - 2. Do not tack weld crossing reinforcing bars.
- C. Preserve clearance between bars of not less than 1 inch (25 mm), not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- D. Provide concrete coverage in accordance with ACI 318 (ACI 318M).
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Splices: Lap splices as indicated on Drawings.
 - 1. Bars indicated to be continuous, and all vertical bars to be lapped not less than 36 bar diameters at splices, or 24 inches (610 mm), whichever is greater.
 - 2. Stagger splices in accordance with ACI 318 (ACI 318M).
 - 3. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.
 - 4. Weld reinforcing bars in accordance with AWS D1.4/D 1.4M, where indicated on Drawings.
- G. Install welded-wire reinforcement in longest practicable lengths.
 - 1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."
 - a. For reinforcement less than W4.0 or D4.0, continuous support spacing to not exceed 12 inches (305 mm).

2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches (50 mm) for plain wire and 8 inches (200 mm) for deformed wire.
3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
4. Lace overlaps with wire.

3.3 JOINTS

- A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 1. Place joints perpendicular to main reinforcement.
 2. Continue reinforcement across construction joints unless otherwise indicated.
 3. Do not continue reinforcement through sides of strip placements of floors and slabs.

3.4 INSTALLATION TOLERANCES

- A. Comply with ACI 117 (ACI 117M).

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
 1. Steel-reinforcement placement.
 2. Steel-reinforcement mechanical splice couplers.
 3. Steel-reinforcement welding.

END OF SECTION 03 20 00

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SECTION 03 30 00 – CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mix design, placement procedures, and finishes for the following:
 - 1. Footings.
 - 2. Foundation walls.
 - 3. Slabs-on-grade.
 - 4. Building frame members.
 - 5. Building walls.
- B. Related Sections include the following:
 - 1. Division 2 Section "Earthwork" for drainage fill under slabs-on-grade.
 - 2. Division 2 Section "Concrete Sidewalk" for concrete pavement and walks.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.
- B. Integral Waterproofing Admixtures (IWPA): Concrete admixture that reacts with the calcium hydroxide created by the Portland cement reaction with water and the free water in concrete to eliminate the route of water ingress making the concrete impermeable.
- C. Water Vapor Reducing Admixtures (WVRA): Concrete admixture that reacts with the calcium hydroxide created by the Portland cement reaction with water and the free water in concrete to eliminate the route of moisture migration and eliminate the free water chemically.
- D. W/C Ratio: The ratio by weight of water to cementitious materials

1.4 SUBMITTALS

- A. Product Data: For each type of manufactured material and product indicated.

- B. Design Mixes: For each concrete mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments. Do not start concrete production until data has been reviewed and approved by the engineer.
- C. Steel Reinforcement Shop Drawings: Details of fabrication, bending, and placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement." Include material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports of concrete reinforcement. Include special reinforcement required for openings through concrete structures.
- D. Welding Certificates: Copies of certificates for welding procedures and personnel.
- E. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:
 - 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- F. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:
 - 1. Cementitious materials and aggregates.
 - 2. Form materials and form-release agents.
 - 3. Steel reinforcement and reinforcement accessories.
 - 4. Admixtures.
 - 5. Curing materials.
 - 6. Floor and slab treatments.
 - 7. Vapor retarders.
 - 8. Epoxy joint filler.
 - 9. Joint-filler strips.
 - 10. Repair materials.
 - 11. Form liners
 - 12. Reglets
 - 13. Vapor retarder/barrier

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed concrete Work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance. A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

- B. 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 formwork and shoring and reshoring installations that are similar to those indicated for this Project in material, design, and extent.
- C. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
 - 1. Manufacturer must be certified according to the National Ready Mixed Concrete Association's Certification of Ready Mixed Concrete Production Facilities.
- D. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548. Contractor shall provide a storage box for concrete cylinders.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
- E. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.
- F. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."
- G. ACI Publications: Comply with the following, unless more stringent provisions are indicated:
 - 1. ACI 301, "Specification for Structural Concrete."
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials." CRSI
- H. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- I. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."
 - 1. Before submitting design mixes, review concrete mix design and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.

- b. Independent testing agency responsible for concrete design mixes.
- c. Ready-mix concrete producer.
- d. Concrete subcontractor.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle steel reinforcement to prevent bending and damage.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Plywood, metal, or other approved panel materials.
 - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1, or better.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.
- D. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- E. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of the exposed concrete surface.
 - 2. Furnish ties that, when removed, will leave holes not larger than 1 inch in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

2.3 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected or CRSI Class 2 stainless-steel bar supports.
- B. Joint Dowel Bars: Plain-steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.
- C. All hooks, unless otherwise noted, shall conform to "ACI Standard Hooks".
- D. Tie-wire shall not be less than 16 gauge wire

2.4 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I/II.
- B. Normal-Weight Aggregate: ASTM C 33, uniformly graded, and as follows:
 - 1. Nominal Maximum Aggregate Size: 3/4 inch.
- C. Fly Ash : ASTM C618, Type F
- D. Water: Potable and complying with ASTM C 94.

2.5 ADMIXTURES

- A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride.
- B. Air-Entraining Admixture: ASTM C 260.
- C. Water-Reducing Admixture: ASTM C 494, Type A.

- D. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
- E. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.
- F. Water-Reducing and Retarding Admixture” ASTM C 494, Type D.
- G. WVRA: ASTM C 494/C 494M, Type S; complex catalyzed hydrous silicate, water and vapor proofing liquid admixture.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide, Specialty Products Group; Vapor Lock 20/20™ or comparable product by one of the following:
 - a. Concure.
 - b. Moxie International

2.6 VAPOR BARRIER SYSTEM

- A. Vapor Barrier System: ASTM E 1745, Class A, polyolefin sheet, not less than 10 mil.
- B. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a No. 4 sieve and 10 to 30 percent passing a No. 100 sieve; meeting deleterious substance limits of ASTM C 33 for fine aggregates.
- C. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

2.7 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Clear, Solvent-Borne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.
- F. Available Products: Subject to compliance with requirements, products 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. Evaporation Retarder:
 - a. Sure Film; Dayton Superior Corporation.
 - b. Eucobar; Euclid Chemical Co.
 - c. E-Con; L&M Construction Chemicals, Inc.
 - d. Confilm; Master Builders, Inc.
 - e. Waterhold; Metalcrete Industries.
 - f. Rich Film; Richmond Screw Anchor Co.
 - g. SikaFilm; Sika Corporation.
 - h. Finishing Aid; Symons Corporation.
 2. Clear, Solvent-Borne, Membrane-Forming Curing Compound:
 - a. Nitocure S; Fosroc.
 - b. Cure & Seal 309; Kaufman Products Inc.
 - c. L&M Dress & Seal 18; L&M Construction Chemicals, Inc.
 - d. CS-309; W. R. Meadows, Inc.
 - e. Seal N Kure; Metalcrete Industries.
 - f. Rich Seal 14 percent UV; Richmond Screw Anchor Co.
 - g. Kure-N-Seal; Sonneborn, Div. of ChemRex, Inc.
 - h. Clear Seal 150; Tamms Industries Co., Div. of LaPorte Construction Chemicals of North America, Inc.
 3. Clear, Waterborne, Membrane-Forming Curing Compound:
 - a. Safe Cure and Seal; Dayton Superior Corporation.
 - b. Aqua Cure VOX; Euclid Chemical Co.
 - c. Dress & Seal WB; L&M Construction Chemicals, Inc.
 - d. Vocomp-20; W. R. Meadows, Inc.
 - e. Metcure; Metalcrete Industries.
 - f. Cure & Seal 150E; Nox-Crete Products Group, Kinsman Corporation.
 - g. Cure & Seal 14 percent E; Symons Corporation.
 - h. Seal Cure WB 150; Tamms Industries Co., Div. of LaPorte Construction Chemicals of North America, Inc.

2.8 RELATED MATERIALS

- A. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Epoxy Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Shore A hardness of 80 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

- D. Epoxy-Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements, and as follows:
 - 1. Type II, non-load bearing, for bonding freshly mixed concrete to hardened concrete.
 - 2. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
 - 3. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Reglets: Fabricate reglets of not less than 0.0217-inch- thick galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- F. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than 0.0336 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.9 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Topping: Traffic-bearing, cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.10 CONCRETE MIXES

- A. Prepare design mixes for each type and strength of concrete determined by either laboratory trial mix or field test data bases, as follows:
 - 1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.
- B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the laboratory trial mix basis.
- C. Footings and Foundation Walls: Proportion normal-weight concrete mix as follows:
 - 1. Compressive Strength (28 Days): 4000 psi.
 - 2. Maximum Slump: 3 inches.
 - 3. Maximum Slump for Concrete Containing High-Range Water-Reducing Admixture: 8 inches after admixture is added to concrete with site-verified 2- to 3-inch slump.
- D. Slab-on-Grade: Proportion normal-weight concrete mix as follows:
 - 1. Compressive Strength (28 Days): 4000 psi.
 - 2. Maximum Slump: 4 inches.
- E. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash: 25 percent.
- F. Maximum Water-Cementitious Materials Ratio: 0.40 for concrete required to have low water permeability. This includes walls below grade.
- G. Maximum Water-Cementitious Materials Ratio: 0.40 for concrete exposed to deicers or subject to freezing and thawing while moist. This includes exterior slabs and walls.
- H. Maximum Water-Cementitious Materials Ratio: 0.40 for corrosion protection of steel reinforcement in concrete exposed to chlorides from deicing chemicals, salt, saltwater, brackish water, seawater, or spray from these sources.
- I. Maximum Water-Cementitious Materials Ratio: 0.40 for all interior slabs.
- J. Air Content: Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows within a tolerance of plus 1 or minus 1.5 percent, unless otherwise indicated:
 - 1. Air Content: 6 percent for 1-inch- nominal maximum aggregate size.
 - 2. Air Content: 6 percent for 3/4-inch- nominal maximum aggregate size.
- K. Do not air entrain concrete to trowel-finished interior floors. Do not allow entrapped air content to exceed 3 percent.

- L. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- M. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 - 4. Use corrosion-inhibiting admixture in concrete mixes where indicated.
 - 5. Use vapor proofing liquid admixture in concrete mixes at all concrete walls and slabs on grade.

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 and ASTM C 1116, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Only when specifically approved by the Architect. Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.
 - 1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least one and one-half minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
 - 2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
 - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
 - 1. Class A, 1/8 inch for surfaces exposed to view.
 - 2. Class C, 1/2 inch all other surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.
 - 1. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor bolts, accurately located, to elevations required.
 - 2. Install reglets to receive top edge of foundation sheet waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 - 3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork, for sides of beams, walls, columns, and similar parts of the Work, that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete provided concrete is hard enough to not be damaged by form-removal operations and provided curing and protection operations are maintained.
- B. Leave formwork, for beam soffits, joists, slabs, and other structural elements, that supports weight of concrete in place until concrete has achieved the following:
 - 1. At least 70 percent of 28-day design compressive strength.
- C. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORES AND RESHORES

- A. Comply with ACI 318, ACI 301, and recommendations in ACI 347R for design, installation, and removal of shoring and reshoring.
- B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.
- C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR BARRIER SYSTEM

- A. Vapor Barrier System: Place, protect, and repair vapor-barrier sheets according to ASTM E 1643 and manufacturer's written instructions. Lap joints 6 inches minimum and seal with manufacturer's tape.

3.6 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor barrier. Repair damage and reseal vapor barrier before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 - 1. Shop- or field-weld reinforcement according to AWS D1.4, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire fabric in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.7 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form from preformed galvanized steel, plastic keyway-section forms, or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
 - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-third of concrete thickness, as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete as soon as possible when cutting action will not dislodge aggregate or otherwise damage surface usually 1 to 2 hours depending on mix design, environmental conditions, etc. and before concrete develops random contraction cracks, typically 1 to 2 hours depending on mix design, environmental conditions, etc.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 7 Section "Joint Sealants," are indicated.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Dowel Joints: Install dowel sleeves and dowels or dowel bar and support assemblies at joints where indicated.
1. Use dowel sleeves or lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 WATERSTOPS

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.
- B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.9 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement, unless approved by Architect.
- C. Deposit concrete continuously or in 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 specified. Deposit concrete to avoid segregation.
 - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.

5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, free of humps or hollows, before excess moisture or bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When 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. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.
- F. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R 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 to 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.

3.10 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding ACI 347R limits for class of surface specified.
- 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 defective areas. Remove fins and other projections exceeding 1/8 inch in height.
1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.
- C. Rubbed Finish: Apply the following to smooth-formed finished concrete:

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-Floated 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.

3.11 FINISHING FLOORS AND SLABS

- A. General: Comply with recommendations in ACI 302.1R 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.
1. Apply scratch finish to surfaces indicated and to surfaces to receive concrete floor topping or mortar setting beds for ceramic or quarry tile, portland cement terrazzo, and other bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
1. Apply float finish to surfaces indicated, to surfaces to receive trowel finish, and to floor and slab surfaces to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- D. Trowel Finish: After applying float finish, apply first trowel finish and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighen

until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces indicated and to floor and slab 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 surfaces to the following tolerances, measured within 24 hours according to ASTM E 1155/E 1155M for a randomly trafficked floor surface:
 - a. For thin-set flooring or resilient floor covering: Specified overall values of flatness, F(F) 35; and levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and levelness, F(L) 17.
 - b. For carpet floors: Specified overall values of flatness, F(F) 25; and levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and levelness, F(L) 15.

- E. Trowel and Fine-Broom Finish: Apply a partial trowel finish, stopping after second troweling, to surfaces indicated and to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. Immediately after second troweling, and when concrete is still plastic, slightly scarify surface with a fine broom.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.12 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete Work.
- B. Curbs: Provide monolithic finish to interior curbs where indicated by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

3.13 CONCRETE PROTECTION 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 with recommendations in ACI 305R for hot-weather protection during curing.

- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing by one or a combination of the following methods:
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces, by one or a combination of the following methods:
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods: Select curing method(s) from subparagraphs below. Delete options or restrict use of curing method(s) to specific locations or types of surfaces if required.
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer recommends for use with floor coverings.
 - 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.
 - 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's

written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.14 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least six months. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid epoxy joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.15 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part Portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least 3/4 inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mix as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.16 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage and pay for a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this Article.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mix exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - 2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mix placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mix, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 - 3. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
 - 4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
 - 5. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 - 6. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
 - 7. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of four standard cylinder specimens for each composite sample.
 - a. Cast and field cure one set of four standard cylinder specimens for each composite sample.
 - 8. Compressive-Strength Tests: ASTM C 39; test two laboratory-cured specimens at 7 days and two at 28 days.
 - a. Test two field-cured specimens at 7 days and two at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at age indicated.
- C. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

- D. Strength of each concrete mix will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- E. 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 mix proportions and materials, compressive breaking strength, and type of break for both 7-and 28-day tests.
- F. 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.
- G. 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. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Architect.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- I. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION 03 30 00

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SECTION 04 20 00 - UNIT MASONRY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Concrete block.
- B. Mortar and grout.
- C. Reinforcement and anchorage.
- D. Flashings.
- E. Accessories.

1.2 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- B. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- D. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement.
- E. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- F. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement.
- G. ASTM C1019 - Standard Test Method for Sampling and Testing Grout.
- H. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens).
- I. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete.

- J. ASTM C1506 - Standard Test Method for Water Retention of Hydraulic Cement-Based Mortars and Plasters.
- K. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
- L. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units.
- M. ASTM C91/C91M - Standard Specification for Masonry Cement.
- N. ASTM C140/C140M - Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units.
- O. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.
- P. ASTM C150/C150M - Standard Specification for Portland Cement.
- Q. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
- R. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
- S. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.
- T. ASTM C476 - Standard Specification for Grout for Masonry.
- U. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
- V. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete.
- W. ASTM C1072 - Standard Test Method for Measurement of Masonry Flexural Bond Strength.
- X. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms.
- Y. ASTM D1056 - Standard Specification for Flexible Cellular Materials--Sponge or Expanded Rubber.
- Z. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications.
- AA. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.

BB. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

CC. ASTM E514/E514M - Standard Test Method for Water Penetration and Leakage Through Masonry.

DD. BIA Technical Notes No. 20 - Cleaning Brickwork.

EE. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing.

FF. BIA Technical Notes No. 28B - Brick Veneer/Steel Stud Walls.

GG. BIA Technical Notes No. 46 - Maintenance of Brick Masonry.

HH. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures.

II. NCMA TEK 8-2A - Removal of Stains from Concrete Masonry.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.

1.4 SUBMITTALS

A. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.

B. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.

C. Manufacturer's Certificate: Certify that water repellent admixture manufacturer has certified masonry unit manufacturer as an approved user of water repellent admixture in the manufacture of concrete block.

D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.

2. Include test reports, according to ASTM C1019, for grout mixes required to comply with compressive strength requirement.
- E. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

1.5 QUALITY ASSURANCE

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
- B. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

PART 2 PRODUCTS

2.1 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 E119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.2 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
 1. Provide special shapes for corners, jambs, sashes, movement joints, headers, bonding, and other locations as indicated on drawings.

2. For sills, caps, and similar applications that would otherwise expose unfinished surfaces, provide units without cores or frogs and with exposed surfaces finished.
3. Provide bullnose units for outside corners of interior CMUs unless otherwise indicated.

B. Concrete Block: Comply with referenced standards and as follows:

1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depths as indicated on drawings for specific locations.
2. Load-Bearing Units: ASTM C90, normal weight.

C. Units with Integral Water Repellent: Concrete block units as specified in this section with polymeric liquid admixture added to concrete masonry units at the time of manufacture.

1. Performance of Units with Integral Water Repellent:
 - a. Water Permeance: When tested per ASTM E514/E514M and for a minimum of 72 hours.
 - 1) No water visible on back of wall above flashing at the end of 24 hours.
 - 2) No flow of water from flashing equal to or greater than 0.032 gallons per hour at the end of 24 hours.
 - 3) No more than 25 percent of wall area above flashing visibly damp at end of test.
 - b. Flexural Bond Strength: ASTM C1072; minimum 10 percent increase.
 - c. Compressive Strength: ASTM C1314; maximum 5 percent decrease.
2. Use only in combination with mortar that also has integral water repellent admixture.
3. Use water repellent admixtures for masonry units and mortar by a single manufacturer.
4. Locations: Exposed exterior units and as indicated.

2.3 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color sample.
- B. Hydrated Lime: ASTM C207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredient
- D. Mortar Aggregate: ASTM C144.
 - 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
- E. Grout Aggregate: ASTM C404.
- F. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
- G. Water: Clean and potable.
- H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
- I. Integral Water Repellent Admixture for Mortar: Polymeric liquid admixture added to mortar at the time of manufacture.
 - 1. Use only in combination with masonry units manufactured with integral water repellent admixture.
 - 2. Use only water repellent admixture for mortar from the same manufacturer as water repellent admixture in masonry units.
 - 3. Meet or exceed performance specified for water repellent admixture used in masonry units.

2.4 REINFORCEMENT AND ANCHORAGE

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi), deformed billet bars; galvanized.

- B. Masonry Joint Reinforcement, General: ASTM A951/A951M.
- C. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.
- D. Adjustable Multiple Wythe Joint Reinforcement: ASTM A951/A951M.
 - 1. Type: Truss, with adjustable ties or tabs spaced at 16 in on center.
 - 2. Material: ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/A153M Class B.
 - 3. Size: 0.1875 inch side rods with 0.1483 inch cross rods and adjustable components of 0.1875 inchwire, width of components as required to provide not less than 5/8 inch of mortar coverage from each masonry face.
 - 4. Vertical adjustment: Not more than 1 1/4 inches.
- E. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not less than 5/8 inch of mortar coverage from masonry face.
- F. Two-Piece Wall Ties: Formed steel wire, 0.1875 inch thick, adjustable, eye and pintle type, hot dip galvanized to ASTM A 153/A 153M, Class B, sized to provide not less than 5/8 inch of mortar coverage from masonry face and to allow vertical adjustment of up to 1-1/4 in.
- G. Metal-to-Metal Fasteners: Self-drilling, self-tapping screws; corrosion resistant finish or hot dip galvanized to ASTM A153/A153M.

2.5 FLASHINGS

- A. Metal Flashing Materials:
 - 1. Stainless Steel Flashing: ASTM A666, Type 304, soft temper; 26 gauge, 0.0187 inch thick; finish 2B to 2D. Stainless Steel shall be DFARS (Defense Federal Acquisition Regulation Supplement).
- B. Factory-Fabricated Flashing Corners and End Dams: Stainless steel. Stainless Steel shall be DFARS (Defense Federal Acquisition Regulation Supplement).

- C. Flashing Sealant/Adhesives: Silicone, polyurethane, or silyl-terminated polyether/polyurethane or other type required or recommended by flashing manufacturer; type capable of adhering to type of flashing used.
- D. Termination Bars: manufacturer's standard continuous length 1" Stainless steel bar with sealant lip complete with stainless steel fasteners; compatible with membrane and adhesives.
- E. Lap Sealants and Tapes: As recommended by flashing manufacturer; compatible with membrane and adhesives.

2.6 ACCESSORIES

- A. Compressible Filler : Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane.
- B. Preformed Control-Joint Gaskets : Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D226/D226M, Type I ("No.15" asphalt felt).
- D. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in place. Units are formed from 0.148-inch (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
- E. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials. Use manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

2.7 MORTAR AND GROUT MIXES

- A. Mortar for Unit Masonry: ASTM C270, using the Property Specification.
 - 1. Masonry below grade and in contact with earth: Type M.

- B. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.
 - 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 C476, Table 1 or paragraph 4.2.2. for specified 28-day compressive strength indicated, but no less than 3000 psi.
 - 3. Provide grout with a slump of 8 to 11 inches (203 to 279 mm) as measured according to ASTM C143/C143M.
- C. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.
- D. Mixing: Use mechanical batch mixer and comply with referenced standards.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.
- D. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.3 COLD AND HOT WEATHER REQUIREMENTS

- A. Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

3.4 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
 - 1. Bond: Running, unless otherwise indicated.
 - 2. Coursing: One unit and one mortar joint to equal 8 inches.
 - 3. Mortar Joints: Concave.

3.5 PLACING AND BONDING

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Lay hollow masonry units with face shell bedding on head and bed joints.
- C. Battering corners of joints or excessive furrowing of mortar joints is not permitted.
- D. Remove excess mortar and mortar smears as work progresses.
- E. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.
- F. Interlock intersections and external corners, except for units laid in stack bond.
- G. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- H. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- I. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.

- J. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

3.6 REINFORCEMENT AND ANCHORAGE - GENERAL, SINGLE WYTHE MASONRY, AND CAVITY WALL MASONRY

- A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement not more than 8 inches on center in foundation walls and parapet walls.
- C. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- D. Place continuous joint reinforcement in first and second joint below top of walls.
- E. Lap joint reinforcement ends minimum 6 inches.
- F. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 36 inches horizontally and 24 inches vertically.

3.7 MASONRY FLASHINGS

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
 - 1. Extend flashings full width at such interruptions and at least 6 inches, minimum, into adjacent masonry or turn up flashing ends at least 1 inch, minimum, to form watertight pan at non-masonry construction.
 - 2. Remove or cover protrusions or sharp edges that could puncture flashings.
 - 3. Seal lapped ends and penetrations of flashing before covering with mortar.
- B. Extend metal flashings to within 1/2 inch of exterior face of masonry and adhere to top of stainless steel angled drip with hemmed edge.
- C. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.

3.8 GROUTED COMPONENTS

- A. Lap splices minimum 24 bar diameters.
- B. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
- C. Place and consolidate grout fill without displacing reinforcing.

3.9 CONTROL JOINTS IN CONCRETE MASONRY

- A. Install control joints at locations indicated on the drawings in all concrete masonry walls.
- B. Nonstructural reinforcement, such as horizontal joint reinforcement, shall not be continuous through control joints.
- C. Structural reinforcement, such as bond beam reinforcement, shall be continuous through control joints.
- D. Install preformed control joint gaskets in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.

3.10 TOLERANCES

- A. Maximum Variation from Alignment of Columns: 1/4 inch.
- B. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
- C. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
- D. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
- E. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
- F. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.
- G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.11 CUTTING AND FITTING

- A. Cut and fit for chases. Coordinate with other sections of work to provide correct size, shape, and location.
- B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.12 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Engage and pay for 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 comply with specified requirements shall be done at Contractor's expense.
- B. Inspections: Special inspections according to the International Building Code and the inspection tables indicated on the structural drawings.
 - 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, laps, and locations of reinforcement.
 - 3. Place grout only after inspectors have verified proportions of site-prepared grout.
 - 4. Inspect all masonry vertical reinforcement.
- C. Testing Prior to Construction: One set of tests.
- D. Testing Frequency: One set of tests for each 1500 sq. ft. of wall area or portion thereof.
- E. Clay Masonry Unit Test: For each type of unit provided, according to ASTM C67 for compressive strength.
- F. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C140/C140M for compressive strength.
- G. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C780.
- H. Mortar Test (Property Specification): For each mix provided, according to ASTM C780. Test mortar for mortar air content and compressive strength.

- I. Grout Test (Compressive Strength): For each mix provided, according to ASTM C1019.

3.13 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- C. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 4. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes No. 20.
 - 5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
 - 6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.
 - 7. Clean stone trim to comply with stone supplier's written instructions.

3.14 PROTECTION

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.
 2. Extend cover a minimum of 24 inches (600 mm) down both sides of walls and hold cover securely in place.
 3. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (600 mm) down face next to unconstructed wythe and hold cover in place.
- B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 2. Protect sills, ledges, and projections from mortar droppings.
 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

END OF SECTION 04 20 00

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SECTION 04 72 00 - CAST STONE MASONRY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Architectural cast stone.
- B. Units required are:
 - 1. Exterior wall units, including wall caps and coping.

1.2 REFERENCE STANDARDS

- A. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement.
- B. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
- C. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement.
- D. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- E. ASTM C33/C33M - Standard Specification for Concrete Aggregates.
- F. ASTM C150/C150M - Standard Specification for Portland Cement.
- G. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
- H. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
- I. ASTM C1364 - Standard Specification for Architectural Cast Stone.

1.3 SUBMITTALS

- A. Product Data: Test results of cast stone components made previously by the manufacturer.
- B. Shop Drawings: Include elevations, dimensions, layouts, profiles, cross sections, reinforcement, exposed faces, arrangement of joints, anchoring methods, anchors, and piece numbers.

- C. Mortar Color Selection Samples.
- D. Verification Samples: Pieces of actual cast stone components not less than 6 inches square, illustrating range of color and texture to be anticipated in components furnished for the project.
- E. Manufacturer's Qualification Data: Documentation showing compliance with specified requirements.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. A firm with a minimum of 5 years experience producing cast stone of types required for project.
2. Current producer member of the Cast Stone Institute or the Architectural Precast Association.
3. Manufacturer's production facility currently holds a Plant Certification from the Cast Stone Institute or the Architectural Precast Association.
4. Adequate plant capacity to furnish quality, sizes, and quantity of cast stone required without delaying progress of the work.

- ##### B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver cast stone components secured to shipping pallets and protected from damage and discoloration. Protect corners from damage.
- B. Store cast stone components and installation materials in accordance with manufacturer's instructions.
- C. Store mortar materials where contamination can be avoided.
- D. Schedule and coordinate production and delivery of cast stone components with unit masonry work to optimize on-site inventory and to avoid delaying the work.

PART 2 PRODUCTS

2.1 ARCHITECTURAL CAST STONE (KEYNOTE: 047200-A)

- A. Cast Stone: Architectural concrete product manufactured to simulate appearance of natural granite, complying with ASTM C1364.
 - 1. Compressive Strength: As specified in ASTM C1364; calculate strength of pieces to be field cut at 80 percent of uncut piece.
 - 2. Freeze-Thaw Resistance: Demonstrated by laboratory testing in accordance with ASTM C1364.
 - 3. Surface Texture: Fine grained texture, with no bugholes, air voids, or other surface blemishes visible from distance of 10 feet.
 - 4. Color: Selected by Architect from manufacturer's full range.
 - 5. Remove cement film from exposed surfaces before packaging for shipment.
- B. Shapes: Provide shapes indicated on drawings.
 - 1. Variation from Any Dimension, Including Bow, Camber, and Twist: Maximum of plus/minus 1/8 inch or length divided by 360, whichever is greater, but not more than 1/4 inch.
 - 2. Unless otherwise indicated on drawings, provide:
 - a. Wash or slope of 1:12 on exterior horizontal surfaces.
 - b. Drips on projecting components, wherever possible.
 - c. Raised fillets at back of sills and at ends to be built in.
 - d. Length: 5'-0" or Maximum available.
- C. Reinforcement: Provide reinforcement as required to withstand handling and structural stresses; comply with ACI 318.

2.2 MATERIALS

- A. Portland Cement: ASTM C150/C150M.
 - 1. For Mortar: Type I or II, except Type III may be used in cold weather.

- B. Coarse Aggregate: ASTM C33/C33M, except for gradation; granite, quartz, or limestone.
- C. Fine Aggregate: ASTM C33/C33M, except for gradation; natural or manufactured sands.
- D. Admixtures: ASTM C494/C494M.
- E. Water: Potable.
- F. Reinforcing Bars: ASTM A615/A615M, Grade 40 (40,000 psi), deformed bars, galvanized.
 - 1. Galvanized in accordance with ASTM A767/A767M, Class I.
- G. Steel Welded Wire Reinforcement: ASTM A1064/A1064M, galvanized or ASTM A884/A884M, epoxy coated.
- H. Embedded Anchors, Dowels, and Inserts: Type 304 stainless steel, of type and size as required for conditions.
- I. Mortar: Portland cement-lime, ASTM C270 Type N ; do not use masonry cement.
- J. Sealant: As specified in Section 07 92 00 .
- K. Cleaner: General-purpose cleaner designed for removing mortar and grout stains, efflorescence, and other construction stains from new masonry surfaces without discoloring or damaging masonry surfaces; approved for intended use by cast stone manufacturer and by cleaner manufacturer for use on cast stone and adjacent masonry materials.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine construction to receive cast stone components. Notify Architect if construction is not acceptable.
- B. Do not begin installation until unacceptable conditions have been corrected.

3.2 INSTALLATION

- A. Mechanically anchor each cast stone unit.

B. Setting:

1. Drench cast stone components with clear, running water immediately before installation.
2. Set units in a full bed of mortar unless otherwise indicated.
3. Fill vertical joints with mortar.
4. Fill dowel holes and anchor slots completely with mortar or non-shrink grout.

3.3 TOLERANCES

A. Joints: Make all joints 3/8 inch, except as otherwise detailed.

1. Rake mortar joints 3/4 inch for pointing.
2. Remove excess mortar from face of stone before pointing joints.
3. Point joints with mortar in layers 3/8 inch thick and tool to a slight concave profile.
4. Leave the following joints open for sealant:
 - a. Head joints in top courses, including copings, parapets, cornices, sills, and steps.
 - b. Joints in projecting units.
 - c. Joints between rigidly anchored units, including soffits, panels, and column covers.
 - d. Joints labeled "expansion joint".

B. Installation Tolerances:

1. Variation from Plumb: Not more than 1/8 inch in 10 feet or 1/4 inch in 20 feet or more.
2. Variation from Level: Not more than 1/8 inch in 10 feet or 1/4 inch in 20 feet, or 3/8 inch maximum.
3. Variation in Joint Width: Not more than 1/8 inch in 36 inches or 1/4 of nominal joint width, whichever is less.

4. Variation in Plane Between Adjacent Surfaces (Lipping): Not more than 1/16 inch difference between planes of adjacent units or adjacent surfaces indicated to be flush with units.

3.4 CLEANING

- A. Keep cast stone components clean as work progresses.
- B. Clean completed exposed cast stone after mortar is thoroughly set and cured.
 1. Wet surfaces with water before applying cleaner.
 2. Apply cleaner to cast stone in accordance with manufacturer's instructions.
 3. Remove cleaner promptly by rinsing thoroughly with clear water.
 4. Do not use acidic cleaners.

3.5 PROTECTION

- A. Protect completed work from damage.
- B. Clean or replace damaged or mortar-splashed work to condition of new work.

END OF SECTION 04 72 00

SECTION 05 12 00 – STRUCTURAL STEEL

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 structural steel.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 1 Section "Quality Control" for independent testing agency procedures and administrative requirements.
 - 2. Division 5 Section "Metal Fabrications" for loose steel bearing plates and miscellaneous steel framing.
 - 3. Division 9 Section "Painting" for surface preparation and priming requirements.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Engineer structural steel connections required by the Contract Documents to be selected or completed by the fabricator to withstand design loadings indicated.
- B. Engineering Responsibility: Engage a fabricator who utilizes a qualified professional engineer to prepare calculations, Shop Drawings, and other structural data for structural steel connections.

1.4 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for each type of product specified.
- C. Shop Drawings detailing fabrication of structural steel components.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.

3. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify high-strength bolted slip-critical, direct-tension, or tensioned shear/bearing connections.
 4. Include Shop Drawings signed and sealed by a qualified professional engineer responsible for their preparation.
- D. Qualification data for firms and persons specified in the "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. Mill test reports signed by manufacturers certifying that their products, including the following, comply with requirements.
1. Structural steel, including chemical and physical properties.
 2. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
 3. Direct-tension indicators.
 4. Shop primers.
 5. Nonshrink grout.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed structural steel work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Fabricator Qualifications: Engage a firm experienced in fabricating structural steel similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to fabricate structural steel without delaying the Work.
- C. Comply with applicable provisions of the following specifications and documents:
1. AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
 2. AISC's "Specification for Allowable Stress Design of Single-Angle Members."
 3. AISC's "Seismic Provisions for Structural Steel Buildings."
 4. ASTM A 6 "Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use."
 5. Research Council on Structural Connections' (RCSC) "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Professional Engineer Qualifications: A professional engineer who is legally authorized to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined

as those performed for projects with structural steel framing that are similar to that indicated for this Project in material, design, and extent.

- E. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel."
 - 1. Present evidence that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver structural steel to Project site in such quantities and at such times to ensure continuity of installation.
- B. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration.
 - 1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 2. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.7 SEQUENCING

- A. Supply anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 - PRODUCTS

2.1 MATERIALS AS INDICATED.

- A. Structural Wide Flange Steel Shapes: ASTM A 992, Grade 50.
- B. Structural steel channel, angles, plates and bars: ASTM A 36.
- C. Hollow Structural Steel Section: ASTM A 500, Grade B.
- D. Steel Pipe: ASTM A 53, Type E or S, Grade B.

1. Weight Class: Standard unless indicated otherwise.
 2. Finish: Black, except where indicated to be galvanized.
- E. Carbon-Steel Casings: ASTM A 27, Grade 65-35, medium-strength carbon steel.
- F. High-Strength Steel Casings: ASTM A 148, Grade 80-50.
- G. Shear Connectors: ASTM A 108, Grade 1015 through 1020, headed-stud type, cold-finished carbon steel, AWS D1.1, Type B.
- H. Anchor Rods, Bolts, Nuts, and Washers: As follows:
1. Unheaded Rods: ASTM A 36.
 2. Headed Bolts: ASTM A 307, Grade A; carbon-steel, hex-head bolts; and carbon-steel nuts.
 3. Headed Bolts: ASTM A 325, Type 1, heavy hex steel structural bolts and heavy hex carbon-steel nuts. Use where high strength bolts are indicated.
 4. Washers: ASTM A 36.
- I. Nonhigh-Strength Bolts, Nuts, and Washers: ASTM A 307, Grade A; carbon-steel, hex-head bolts; carbon-steel nuts; and flat, unhardened steel washers.
1. Finish: Hot-dip zinc-coating, ASTM A 153, Class C.
- J. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers.
1. Finish: Hot-dip zinc-coating, ASTM A 153, Class C.
- K. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
1. Finish: Mechanically deposited zinc coating.
- L. Welding Electrodes: Comply with AWS requirements.

2.2 PRIMER

- A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer.
- B. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds and repair painting galvanized steel, with dry film containing not less than 93 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, of consistency suitable for application, and a 30-minute working time.

2.4 FABRICATION

- A. Fabricate and assemble structural steel in shop to greatest extent possible. Fabricate structural steel according to AISC specifications referenced in this Section and in Shop Drawings.
 - 1. Camber structural steel members where indicated.
 - 2. Identify high-strength structural steel according to ASTM A 6 and maintain markings until steel has been erected.
 - 3. Mark and match-mark materials for field assembly.
 - 4. Fabricate for delivery a sequence that will expedite erection and minimize field handling of structural steel.
 - 5. Complete structural steel assemblies, including welding of units, before starting shop-priming operations.
 - 6. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.
- B. Fabricate architecturally exposed structural steel with exposed surfaces smooth, square, and free of surface blemishes, including pitting, rust, scale, seam marks, roller marks, rolled trade names and roughness.
 - 1. Remove blemishes by filling or grinding, or by welding and grinding, prior to cleaning, treating, and shop priming.
 - 2. Comply with fabrication requirements, including tolerance limits, of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for architecturally exposed structural steel.
- C. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded.
- D. Finishing: Accurately mill ends of columns and other members transmitting loads in bearing.
- E. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's printed instructions.
- F. Holes: Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members, as shown on Shop Drawings.

1. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in bearing plates.

2.5 SHOP CONNECTIONS

- A. Shop install and tighten high-strength bolts according to RCSC's Allowable Stress Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 1. Bolts: ASTM A 325 high-strength bolts, unless otherwise indicated.
 2. Connection Type: Snug tightened, unless indicated as slip-critical, direct-tension, or tensioned shear/bearing connections.
- B. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.
 1. Remove backing bars or runoff tabs, back gouge, and ground steel smooth.
 2. Assemble and weld built-up sections by methods that will maintain alignment of axes without warp.
 3. Verify that weld sizes, fabrication sequence, and equipment used will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds 1/2 inch and larger. Grind flush butt welds. Dress exposed welds.

2.6 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 2. Surfaces to be field welded.
 3. Surfaces to be high-strength bolted with slip-critical connections.
 4. Surfaces to receive sprayed-on fireproofing.
 5. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Prepare surfaces according to SSPC specifications as follows:
 1. SPC-SP 3 "Power Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 2. Apply 2 coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.

- D. Painting: Apply a 1-coat, nonasphaltic primer complying with SSPC's "Painting System Guide No. 7.00" to provide a dry film thickness of not less than 1.5 mils.

2.7 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel indicated for galvanizing according to ASTM A 123.

2.8 SOURCE QUALITY CONTROL

- A. Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
 - 1. Testing agency will conduct and interpret tests and state in each report whether test specimens comply with or deviate from requirements.
 - 2. Provide testing agency with access to places where structural steel Work is being fabricated or produced so required inspection and testing can be accomplished.
- B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.
- C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.
- D. Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 - 1. Direct-tension indicator gaps will be verified to comply with ASTM F 959, Table 2.
- E. In addition to visual inspection, shop-welded connections will be inspected and tested according to AWS D1.1 and the inspection procedures listed below, 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Before erection proceeds, and with the steel erector present, verify elevations of concrete and masonry bearing surfaces and locations of anchorages for compliance with requirements.

- B. Do not proceed with erection until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC specifications referenced in this Section.
- B. Base and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.
 - 1. Set base and bearing plates for structural members on leveling plates, wedges, shims, or setting nuts as required.
 - 2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.
 - 3. Pack grout solidly between bearing surfaces and plates so no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.
 - a. Comply with manufacturer's instructions for proprietary grout materials.
- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.
- E. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.
- F. Do not use thermal cutting during erection.

- G. Splice members only where indicated.
- H. Finish sections thermally cut during erection equal to a sheared appearance.
- I. Do not enlarge unfair holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

- A. Install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 - 1. Bolts: ASTM A 325 high-strength bolts, unless otherwise indicated.
 - 2. Connection Type: Snug tightened, unless indicated as slip-critical, direct-tension, or tensioned shear/bearing connections.
- B. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.
 - 1. Comply with AISC specifications referenced in this Section for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
 - 2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.
 - 3. Verify that weld sizes, fabrication sequence, and equipment used will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds 1/2 inch and larger. Grind flush butt welds. Dress exposed welds.

3.5 FIELD QUALITY CONTROL

- A. Owner will employ and pay for an independent testing and inspecting agency to perform field inspections and tests and to prepare test reports.
 - 1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements.
- B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.
- C. Additional testing will be performed to determine compliance of corrected Work with specified requirements. Contractor will reimburse Owner for the costs of these additional tests.
- D. Field-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1. Direct-tension indicator gaps will be verified to comply with ASTM F 959, Table 2.
- E. In addition to visual inspection, field-welded connections will be inspected and tested according to AWS D1.1 and the inspection procedures listed below, 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.
- 3.6 CLEANING
 - A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.
 1. Apply by brush or spray to provide a minimum dry film thickness of 1.5 mils.
 - B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint according to ASTM A 780.

END OF SECTION 05 12 00

SECTION 05 12 13 - ARCHITECTURALLY-EXPOSED STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Additional requirements for structural steel members designated as architecturally-exposed structural steel (AESS).

1.2 DEFINITIONS

- A. Architecturally-Exposed Structural Steel: Structural steel complying with designated AESS category as defined in AISC 303.

1.3 REFERENCE STANDARDS

- A. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges.
- B. AISC 360 - Specification for Structural Steel Buildings.
- C. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
- D. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- E. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- F. ASTM A1085/A1085M - Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS).
- G. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
- H. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification.
- I. AWS D1.1/D1.1M - Structural Welding Code - Steel.
- J. SSPC-SP 1 - Solvent Cleaning.

K. SSPC-SP 6 - Commercial Blast Cleaning.

1.4 SUBMITTALS

A. Shop Drawings: Detailing for fabrication of AESS components.

1. Provide erection documents clearly indicating which members are AESS members and the AESS category of each part.
2. Include details that clearly identify AESS requirements found in this specification. Provide connections for AESS consistent with concepts shown on drawings.
3. Indicate welds by AWS A2.4 symbols, distinguishing between shop and field welds, and show size, length and type of each weld. Identify grinding, finish and profile of welds as defined by the designated AESS category.

B. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

C. Qualification data for fabricator and erector to demonstrate their capabilities and experience. Include lists of completed projects names and address, names and addresses of architects and owners, photographs showing detail of installed AESS, and other information specified.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: In addition to those qualifications listed in Section 05 12 00, engage an AISC Certified Fabricator, experienced in fabricating AESS similar to that indicated for this project with a record of successful in-service performance, as well as sufficient production capacity to fabricate AESS without delaying the work.

B. Erector Qualifications: In addition to those qualifications listed in Section 05 12 00, engage an AISC Certified Erector, experienced in erecting AESS work similar in material, design, and extent to that indicated for this project and with a record of successful in-service performance.

C. Welder Qualifications: Welding processes and welding operators qualified within previous 12 months in accordance with AWS D1.1/D1.1M and dated no more than 12 months before start of scheduled welding work..

- D. Comply with applicable provisions of AISC 303, Section 10 for the designated AECS category.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Handle finished pieces in accordance with Section 10 of AISC 303, using nylon-type slings, or chains with softeners, or wire ropes with softeners such that they are not damaged.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Comply with Section 05 12 00, except as amended in this section for aesthetic purposes.

2.2 FABRICATION

- A. Fabricate and assemble AECS in shop to greatest extent possible. Locate field joints in AECS assemblies at concealed locations or as approved by Architect. Detail AECS assemblies to minimize field handling and expedite erection.
- B. Permissible tolerances for member depth, width, out of square, and camber and sweep to be as specified in ASTM A6/A6M, ASTM A500/A500M, and ASTM A1085/A1085M.
- C. Use special care in handling and shipping of AECS both before and after shop painting to minimize damage to any shop finish. Use nylon-type slings or softeners when using chains or wire rope slings.
- D. Surface Preparation:
 - 1. Remove blemishes or unsightly surfaces resulting from temporary braces or fixtures.
 - 2. Remove backing and run out tabs.
- E. Fabricate AECS in accordance with categories defined in AISC 303, as follows:
 - 1. AECS 3: Feature elements viewed at a distance less than 20 feet (feature elements in close view).

2.3 PAINT SYSTEM

- A. Compatibility: All components/procedures of AESS paint system to comply with coating system specified, submitted, and approved per Sections 09 91 23. As a minimum, identify required surface preparation, primer, intermediate coat (if applicable), and finish coat. Primer, intermediate coating, and finish coating to be from a single manufacturer combined in a system documented by manufacturer with adequate guidance for fabricator to procure and execute.
- B. Primer: Organic, epoxy/zinc rich meeting class B surface requirements for slip critical connections, as found in AISC 360. Primer to comply with all federal standards for VOC, lead and chromate levels.

2.4 SHOP PRIMING

- A. Surface Preparation:
 - 1. Provide surface preparations to meet SSPC-SP 6.
 - 2. Coordinate required surface profile with approved paint submittal prior to beginning surface preparation.
 - 3. Prior to blasting, remove any grease and oil using solvent cleaning to meet SSPC-SP 1.
 - 4. Remove weld spatter, slivers and similar surface discontinuities.
 - 5. Ease sharp corners resulting from shearing, flame cutting or grinding.
- B. Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete, or high strength bolted with slip-critical connections.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Erector to check all AESS members upon delivery for twist, kinks, gouges or other imperfections which may result in rejection of appearance of member. Coordinate remedial action with fabricator prior to erecting steel.

3.2 PREPARATION

- A. Handle, lift and align pieces using nylon straps or chains with softeners required to maintain appearance of AESS through process of erection.

3.3 ERECTION

- A. AESS 1 and 2: Basic elements; feature elements not in close view:
 - 1. Employ special care to handle and erect AESS. Erect finished pieces using nylon straps or chains with softeners such that they are not damaged.
 - 2. Place weld tabs for temporary bracing and safety cabling at points concealed from view in completed structure or where approved by Architect during pre-installation meeting. Obtain Architect approval of methods for removing temporary devices and finishing AESS members prior to erection.
 - 3. AESS Erection Tolerances: Erect to standard frame tolerances for structural steel per Chapter 7 of AISC 303.
 - 4. Set AESS accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
 - 5. Remove blemishes or unsightly surfaces resulting from temporary braces or fixtures.
 - 6. Remove all backing and run out tabs.
 - 7. When temporary braces or fixtures are required to facilitate erection, take care to avoid any blemishes, holes or unsightly surfaces resulting from use or removal of such temporary elements.
 - 8. Welded Connections: Comply with AWS D1.1/D1.1M and Section 05 12 00. Appearance and quality of welds to be consistent. Employ methods that will maintain alignment of members without warp exceeding tolerance of this section.
 - 9. Remove weld spatter exposed to view.
 - 10. Grind off projections larger than 1/16 inch at field butt and plug welds.

11. Continuous Welds: Where continuous welding is noted on drawings, provide continuous welds of a uniform size and profile.

B. AESS 3: Feature elements in close view:

1. Erect to requirements of AESS 1 and 2 and as follows:
2. Provide a continuous appearance to all welded joints including tack welds. Provide joint filler at intermittent welds.

3.4 CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas. Repair galvanized surfaces in accordance with ASTM A780/A780M.

END OF SECTION 05 12 13

SECTION 05 31 00 - STEEL DECKING

PART 1 - PRODUCTS

1.1 SUMMARY

A. Section Includes:

1. Roof deck.

B. Related Requirements:

1. Section 03 30 00 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
2. Section 05 12 00 "Structural Steel Framing" for shop- and field-welded shear connectors.
3. Section 05 50 00 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Roof deck.

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Test and Evaluation Reports:

1. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

- a. Power-actuated mechanical fasteners.
 - 2. Research Reports: For steel deck, from ICC-ES showing compliance with the building code.
 - D. Field Quality-Control Submittals:
 - 1. Field quality-control reports.
 - E. Qualification Statements: For welding personnel and testing agency.
- 1.4 QUALITY ASSURANCE
- A. Welding Qualifications: Qualify procedures and personnel in accordance with SDI QA/QC and the following welding codes:
 - 1. AWS D1.1/D1.1M.
 - 2. AWS D1.3/D1.3M.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
 - B. Store products in accordance with SDI MOC3. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck in accordance with AISI S100.
- B. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from listings of another qualified testing agency.

2.2 ROOF DECK

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Vulcraft; Nucor Vulcraft Group; 1.5B-36 GR50 Roof Deck or comparable product by one of the following:
 - 1. ASC Profiles, Inc.
 - 2. Canam Steel Corporation; Canam Group, Inc.
 - 3. Epic Metals Corporation.
 - 4. Marlyn Steel Decks, Inc.
 - 5. New Millennium Building Systems, LLC.
- B. Fabrication of Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with SDI RD and with the following:
 - 1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 40 (275), G60 (Z180)zinc coating.
 - 2. Deck Profile: As indicated
 - 3. Profile Depth: As indicated.
 - 4. Design Uncoated-Steel Thickness: As indicated.
 - 5. Span Condition: Triple span or more.
 - 6. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.3 ACCESSORIES

- A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8-mm) minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359-inch (0.91-mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories in accordance with SDI C, SDI NC, and SDI RD, as applicable; manufacturer's written instructions; and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install in accordance with deck manufacturer's written instructions.

3.3 INSTALLATION OF ROOF DECK

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches (38 mm) long, and as follows:
 - 1. Weld Diameter: 5/8 inch (16 mm) , nominal.
 - 2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds 18 inches (460 mm) apart,

maximum apart in Zone 1 and 6 inches (150 mm) apart in Zones 2 and 3, based on roof-area definitions in FM Global Loss Prevention Data Sheet 1-28.

- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 36 inches (1 m), and as follows:
 - 1. Mechanically fasten with self-drilling, No. 10 (4.8-mm-) diameter or larger, carbon-steel screws.
 - 2. Mechanically clinch or button punch.
 - 3. Fasten with a minimum of 1-1/2-inch- (38-mm-) long welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:
 - 1. End Joints: Lapped 2 inches (50 mm) minimum or butted at Contractor's option.
- D. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels in accordance with deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.
 - 1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
 - 1. Special inspections and qualification of welding special inspectors for cold-formed steel floor and roof deck in accordance with quality-assurance inspection requirements of SDI QA/QC.
 - a. Field welds will be subject to inspection.
 - 2. Steel decking will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 05 31 00

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SECTION 05 40 00 – COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Interior non-load-bearing wall framing.
 - 2. Exterior and interior load-bearing wall framing.
 - 3. Exterior non-load-bearing wall framing.
 - 4. Ceiling joist framing.
 - 5. Diagonal strap bracing.
- B. Related Sections include the following:
 - 1. Division 5 Section "Metal Fabrications" for masonry shelf angles and connections.
 - 2. Division 9 Section "Gypsum Board Assemblies" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.
 - 3. Division 9 Section "Gypsum Board Shaft-Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies.

1.3 DEFINITIONS

- A. Minimum Uncoated Steel Thickness: Minimum uncoated thickness of cold-formed framing delivered to the Project site shall be not less than 95 percent of the thickness used in the cold-formed framing design. Lesser thicknesses shall be permitted at bends due to cold forming.
- B. Producer: Entity that produces steel sheet coil fabricated into cold-formed members.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.
 - 1. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Interior Non-Load-Bearing Wall Framing: Horizontal deflection of 1/360 of the wall height under a horizontal load of 5 lbf/sq. ft.

- b. Exterior Non-Load-Bearing Framing: Horizontal deflection of $1/360$ of the wall height.
 - c. Ceiling Joist Framing: Vertical deflection of $1/360$ of the span.
 - 2. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg. F.
 - 3. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
 - a. Upward and downward movement of $1/2$ inch.
- B. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."
 - 1. Headers: Design according to AISI's "Standard for Cold-Formed Steel Framing - Header Design."
 - 2. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

1.5 SUBMITTALS

- A. Product Data: For each type of cold-formed metal framing product and accessory indicated.
- B. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
 - 1. For cold-formed metal framing indicated to comply with design loads, include structural Analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Mill certificates signed by steel sheet producer or test reports from a qualified independent testing agency indicating steel sheet complies with requirements.
- D. Welding Certificates: Copies of certificates for welding procedures and personnel.
- E. 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.

- F. Product Test Reports: From a qualified testing agency indicating that each of the following complies with requirements, based on comprehensive testing of current products:
 - 1. Expansion anchors.
 - 2. Steel Sheet.
 - 3. Power-actuated anchors.
 - 4. Mechanical fasteners.
 - 5. Vertical deflection clips.
 - 6. Miscellaneous structural clips and accessories.
- G. Research/Evaluation Reports: Evidence of cold-formed metal framing's compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed cold-formed metal framing similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Engineering Responsibility: Engage a qualified professional engineer to prepare design calculations, Shop Drawings, and other structural data.
- C. 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 cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.
- D. Mill certificates signed by steel sheet producer or test reports from a qualified independent testing agency indicating steel sheet complies with requirements, including uncoated steel thickness, yield strength, tensile strength, total elongation, chemical requirements, ductility, and galvanized-coating thickness.
- E. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.
- F. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."
- G. Fire-Test-Response Characteristics: Where metal framing is part of a fire-resistance-rated assembly, provide framing identical to that 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 GA File Numbers in GA-600, "Fire Resistance Design Manual," or by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
- H. AISI Specifications: Comply with AISI's "Specification for the Design of Cold-Formed Steel Structural Members" for calculating structural characteristics of cold-formed metal framing:
1. CCFSS Technical Bulletin: "AISI Specification Provisions for Screw Connections."
- I. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide cold-formed metal framing by one of the following or approved equal:
1. Allied Studco, Inc.
 2. The Steel Network, Inc.
 3. Dietrich Industries, Inc.
 4. AllSteel Products, Inc.
 5. Knorr Steel Framing Systems.
 6. MarinoWare; Div. of Ware Industries, Inc.
 7. Unimast, Inc.
 8. United Metal Products, Inc.
 9. Clark Steel Framing.
 10. Steel Construction Systems.

2.2 MATERIALS

- A. Steel Sheet: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
 - 1. Grade: 33 minimum or as required by structural performance.
 - 2. Coating: G60.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, complying with ASTM C 955, and as follows:
 - 1. Minimum Uncoated-Steel Thickness: Matching steel studs.
- C. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads, and as follows:
 - 1. Minimum Uncoated-Steel Thickness: Matching steel studs.
 - 2. Flange Width: Manufacturer's standard deep flange width
- D. Vertical Deflection Clips: Manufacturer's standard clips, capable of accommodating upward and downward vertical displacement of primary structure.

2.3 EXTERIOR AND INTERIOR LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inch
 - 2. Flange Width: 1-5/8 inches
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness 0.0428 inch
 - 2. Flange Width: 1-1/4 inches

2.4 EXTERIOR AND INTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inch
 - 2. Flange Width: 1-5/8 inches
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness 0.0428 inch

2. Flange Width: 1-1/4 inches
- C. Vertical Deflection Clips: Manufacturer's standard head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dietrich Metal Framing; a Worthington Industries Company.
 - b. MarinoWare, a division of Ware Industries.
 - c. SCAFCO Corporation
 - d. The Steel Network, Inc.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure, and as follows:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dietrich Metal Framing; a Worthington Industries Company.
 - b. MarinoWare, a division of Ware Industries.
 - c. SCAFCO Corporation
 - d. The Steel Network, Inc.
 2. Minimum Base-Metal Thickness: 0.0428
 3. Flange Width: 1 inch plus the design gap for 1-story structures
- E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
 1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure, and as follows:
 - a. Minimum Base-Metal Thickness: 0.0428 inch
 - b. Flange Width: 1 inch plus the design gap for 1-story structures
 2. Inner Track: Of web depth indicated, and as follows:
 - a. Minimum Base-Metal Thickness: 0.0428 inch
 - b. Flange Width: Equal to sum of outer deflection track flange width plus 1 inch
- F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure.

2.5 CEILING JOIST FRAMING

- A. Steel Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, unpunched with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inch
 - 2. Flange Width: 1-5/8 inches

2.6 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
 - 1. Supplementary framing.
 - 2. Bracing, bridging, and solid blocking.
 - 3. Web stiffeners.
 - 4. Anchor clips.
 - 5. End clips.
 - 6. Foundation clips.
 - 7. Gusset plates.
 - 8. Stud kickers, knee braces, and girts.
 - 9. Joist hangers and end closures.
 - 10. Hole reinforcing plates.
 - 11. Backer plates.

2.7 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123.
- B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.
- C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
- D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.

- E. Mechanical Fasteners: Corrosion-resistant-coated, self-drilling, self-threading steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
- F. Welding Electrodes: Comply with AWS standards.

2.8 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035.
- B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, 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.
- C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.
- D. Shims: Load bearing, high-density multimonomer plastic, nonleaching.
- E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.9 FABRICATION

- A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to manufacturer's written recommendations and requirements in this Section.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold-formed metal framing members by welding. Wire tying of framing members is not permitted. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - 4. Fasten cold-formed metal framing members by welding or screw fastening, as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.

5. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.
- B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.
- C. Grout bearing surfaces uniform and level to ensure full contact of bearing flanges or track webs on supporting concrete or masonry construction.
- D. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

- A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

- B. Install cold-formed metal framing according to ASTM C 1007, unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
 - 1. Bolt or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.
- D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to manufacturer's written recommendations and requirements in this Section.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold-formed metal framing members by welding or screw fastening, as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.
- E. Install framing members in one-piece lengths, unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.
- H. Install insulation in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.
- J. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 LOAD-BEARING WALL INSTALLATION

- A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:
 1. Anchor Spacing: As shown on drawings.
- B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:
 1. Stud Spacing: 16 inches (Unless noted otherwise)
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.
- D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.
- E. Align floor and roof framing over studs. Where framing cannot be aligned, continuously reinforce track to transfer loads.
- F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.
- G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
 1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.
 2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.
- H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
 1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.

- I. Install horizontal bridging in stud system, spaced 48 inches. Fasten at each stud intersection.
 - 1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of 2 screws into each flange of the clip angle for framing members up to 6 inches deep.
 - 2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 - 3. Bridging: Proprietary "BridgeBar BB150" wall bridging installed according to manufacturer's written instructions.
- J. Install steel sheet diagonal bracing straps to both stud flanges, terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.
- K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 EXTERIOR AND INTERIOR NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
- B. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as follows:
 - 1. Stud Spacing: 16 inches (Unless noted otherwise)
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 - 1. Install single-leg deflection tracks and anchor to building structure.
 - 2. Install double deep-leg deflection tracks and anchor outer track to building structure.
 - 3. Connect vertical deflection clips to bypassing studs and anchor to building structure.
 - 4. Connect drift clips to cold formed metal framing and anchor to building structure.
- E. Install horizontal bridging in curtain-wall studs, spaced in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.

1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of flat, taut, steel sheet straps of width and thickness indicated and stud or stud-track solid blocking of width and thickness matching studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 - a. Install solid blocking at 96-inch centers or as indicated on Shop Drawings.
 2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
 3. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 4. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable curtain-wall-framing system.

3.6 JOIST INSTALLATION

- A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.
- B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
 1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches
 2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated on Shop Drawings.
- C. Space joists not more than 2 inches from abutting walls, and as follows:
 1. Joist Spacing: As indicated on plan.
- D. Frame openings with built-up joist headers consisting of joist and joist track, nesting joists, or another combination of connected joists if indicated.
- E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated on Shop Drawings.
 1. Install web stiffeners to transfer axial loads of walls above.
- F. Install bridging at intervals indicated on Shop Drawings. Fasten bridging at each joist intersection as follows:

1. Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
 2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.
- G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.
- H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.7 GYPSUM SHEATHING INSTALLATION

- A. General: Install gypsum sheathing to comply with GA-253 and manufacturer's written instructions.
- B. Cut boards at penetrations, edges, and other obstructions of the work; fit tightly against abutting construction, except provide a 3/8-inch setback where non-load-bearing construction abuts structural elements.
- C. Coordinate sheathing installation with flashing and joint sealant installation so these materials are installed in the sequence and manner that prevent exterior moisture from passing through completed exterior wall assembly.
- D. Apply fasteners so screw heads bear tightly against face of sheathing boards but do not cut into facing.
- E. Do not bridge building expansion joints with sheathing; cut and space edges to match spacing of structural support elements.
- F. Horizontal Installation: Install 24-inch- wide gypsum sheathing boards horizontally 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 stud flanges and stagger end joints of adjacent boards not less than one stud spacing. Screw-attach boards at perimeter and within field of board to each steel stud at approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.
- G. Vertical Installation: Install 48-inch wide gypsum sheathing boards vertically with vertical edges centered over flanges of steel studs. Abut ends and edges of each board with those of adjacent boards. Screw-attach boards at perimeter and within field of

board to each steel stud at approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.

- H. Air-Infiltration Barrier Application: Cover sheathing with air-infiltration barrier as follows:
 - 1. Cut back air-infiltration barrier 1/2 inch on each side of break in supporting members at expansion- or control-joint locations.
 - 2. Apply asphalt-saturated organic felt horizontally with 2-inch overlap and 6-inch end lap; fasten to sheathing with corrosion-resistant staples.
 - 3. Apply proprietary building wrap to comply with manufacturer's written installation instructions.
 - 4. Apply air-infiltration barrier to cover vertical flashing with 4-inch overlap.
- I. Sealing Sheathing Joints: Seal joints according to sheathing manufacturer's written recommendations and as follows:
 - 1. Apply elastomeric sealant on joints and fasteners and trowel flat. Apply sufficient quantity 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 board joints, and apply and trowel silicone emulsion sealant to embed sealant in entire face of tape. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

3.8 FIELD QUALITY CONTROL

- A. Testing: Owner will employ and pay for a qualified independent testing agency to perform field quality-control testing.
- B. Field and shop welds will be subject to inspection and testing.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Remove and replace Work that does not comply with specified requirements.
- E. Additional testing and inspecting will be performed to determine compliance of corrected Work with specified requirements. Contractor will reimburse Owner for the costs of these additional tests.

3.9 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

- B. Touchup Painting: Wire brush, clean, and paint scarred areas, welds, and rust spots on fabricated and installed prime-painted, cold-formed metal framing. Paint framing surfaces with same type of shop paint used on adjacent surfaces.
- C. Protect paper-surfaced gypsum sheathing that will be exposed to weather for more than 30 days by covering exposed exterior surface of sheathing with a securely fastened air-infiltration barrier. Apply covering immediately after sheathing is installed.
- D. Protect cutouts, corners, and joints in sheathing by filling with a flexible sealant or by applying tape recommended by sheathing manufacturer at time sheathing is applied.
- E. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 40 00

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Shop fabricated steel and aluminum items.
- B. Steel framing and supports for applications where framing and supports are not specified in other Sections.
- C. Roof Mounted Fall-Arrest Anchors

1.2 REFERENCE STANDARDS

- A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
- B. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
- D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- E. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- F. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- G. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
- H. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
- I. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

- J. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
- K. ASTM B210/B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes.
- L. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire.
- M. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- N. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- O. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric].
- P. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- Q. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric].
- R. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.
- S. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
- T. AWS D1.1/D1.1M - Structural Welding Code - Steel.
- U. AWS D1.2/D1.2M - Structural Welding Code - Aluminum.
- V. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel; International Accreditation Service, Inc..
- W. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer.
- X. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic").
- Y. SSPC-SP 2 - Hand Tool Cleaning.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
- 1. Design data: Submit drawings and supporting calculations, signed and sealed by a qualified professional structural engineer.
 - a. Include the following, as applicable:
 - 1) Design criteria.
 - 2) Engineering analysis depicting stresses and deflections.
 - 3) Member sizes and gauges.
 - 4) Details of connections.
 - 5) Support reactions.

1.4 QUALITY ASSURANCE

- A. Design metal fabrications under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
- B. Fabricator Qualifications: A qualified steel fabricator that is accredited by IAS AC172.

PART 2 PRODUCTS

2.1 MATERIALS - STEEL

- A. Steel Sections: ASTM A36/A36M.
- B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.
- C. Plates: ASTM A283/A283M.
- D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
- E. Slotted Channel Framing: ASTM A653/A653M, Grade 33.
- F. Slotted Channel Fittings: ASTM A1011/A1011M.

- G. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.
- H. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, galvanized to ASTM A153/A153M where connecting galvanized components.
- I. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- J. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- K. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.2 MATERIALS - ALUMINUM

- A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.
- B. Sheet Aluminum: ASTM B209/B209M, 5052 alloy, H32 or H22 temper.
- C. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210/B210M, 6063 alloy, T6 temper.
- D. Aluminum-Alloy Bars: ASTM B211/B211M, 6061 alloy, T6 temper.
- E. Bolts, Nuts, and Washers: Stainless steel.
- F. Welding Materials: AWS D1.2/D1.2M; type required for materials being welded.

2.3 FABRICATION

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Continuously seal joined members by continuous welds.
- D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

- F. Furnish components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.4 FABRICATED ITEMS

- A. Ledge Angles, Shelf Angles, Channels, and Plates not attached to Structural Framing including, but not limited to:
 - 1. Curtainwall and storefront head, sill, and jamb locations as shown on drawings and required by design loads.
- B. Lintels: As detailed.
 - 1. Exterior: Prime paint finish, unpainted.
 - 2. Interior: Prime paint finish.
- C. Slotted Channel Framing: Fabricate channels and fittings from structural steel complying with the referenced standards; factory-applied, rust-inhibiting thermoset acrylic enamel finish.
- D. Roof Mounted Fall-Arrest Anchor (KEYNOTE: 055000-R)
 - 1. ASTM A36 Galvanized Steel Anchor
 - 2. Height: 26 inch
 - 3. Post Diameter: 4.5 inch
 - 4. User Maximum Capacity: Minimum 420 pounds
 - 5. Tensile Strength: 5000 lbf/22kN
 - 6. U-loop cross section: 0.625 inch min

2.5 FINISHES - STEEL

- A. Prime paint steel items.
 - 1. Exceptions: Galvanize items to be embedded in concrete, items to be embedded in masonry, and any items which are located in exterior walls.

2. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required, and items to be covered with sprayed fireproofing.

- B. Prime Painting: One coat.
- C. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements.
- D. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.

2.6 FINISHES - ALUMINUM

- A. Exterior Aluminum Surfaces: superior performance organic coating.
- B. Interior Aluminum Surfaces: high performance organic coating.
- C. High Performance Organic Coating System: AAMA 2604 multiple coat, thermally cured fluoropolymer system; color as indicated.
- D. Superior Performance Organic Coating System: AAMA 2605 multiple coat, thermally cured polyvinylidene fluoride system; color as indicated.

2.7 FABRICATION TOLERANCES

- A. Squareness: 1/8 inch maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch.
- C. Maximum Misalignment of Adjacent Members: 1/16 inch.
- D. Maximum Bow: 1/8 inch in 48 inches.
- E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.2 PREPARATION

- A. Clean and strip primed steel items to bare metal and aluminum where site welding is required.
- B. Furnish setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.3 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Obtain approval prior to site cutting or making adjustments not scheduled.
- D. After erection, prime welds, abrasions and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.4 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION 05 50 00

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SECTION 05 51 00 - METAL STAIRS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Stairs with concrete treads.
- B. Structural steel stair framing and supports.

1.2 REFERENCE STANDARDS

- A. AISC 201 - AISC Certification Program for Structural Steel Fabricators, Standard for Steel Building Structures.
- B. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
- C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
- D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- E. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
- F. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- G. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
- H. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
- I. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
- J. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.

- K. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
- L. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification.
- M. AWS D1.1/D1.1M - Structural Welding Code - Steel.
- N. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel; International Accreditation Service, Inc..
- O. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer.
- P. SSPC-SP 2 - Hand Tool Cleaning.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
 - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
- B. Calculations: Signed and sealed by a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.
- C. Design Data: As required by authorities having jurisdiction.
- D. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

1.4 QUALITY ASSURANCE

- A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.
- B. Fabricator Qualifications:
 - 1. A qualified steel fabricator that is certified by the American Institute for Steel Construction (AISC) under AISC 201.

2. A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.

PART 2 PRODUCTS

2.1 METAL STAIRS - GENERAL

- A. Metal Stairs: Provide stairs of the design specified, complete with landing platforms, vertical and horizontal supports, railings, and guards, fabricated accurately for anchorage to each other and to building structure.
 1. Regulatory Requirements: Provide stairs and railings that comply with most stringent requirements of local, state, and federal regulations; where requirements of Contract Documents exceed those of regulations, comply with Contract Documents.
 2. Structural Design: Provide complete stair and railing assemblies that comply with the applicable local code.
 3. Dimensions: As indicated on drawings.
 4. Shop assemble components; disassemble into largest practical sections suitable for transport and access to site.
 5. No sharp or rough areas on exposed travel surfaces and surfaces accessible to touch.
 6. Separate dissimilar metals using paint or permanent tape.
- B. Metal Jointing and Finish Quality Levels:
 1. Architectural: All joints as inconspicuous as possible, whether welded or mechanical.
 - a. Welded Joints: Continuously welded and ground smooth and flush.
 - b. Mechanical Joints: Butted tight, flush, and hairline; concealed fastenings only.
 - c. Exposed Edges and Corners: Eased to small uniform radius.

- d. Metal Surfaces to be Painted: Sanded or ground smooth, suitable for highest quality gloss finish.
- C. Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.
- D. Anchors and Related Components: Same material and finish as item to be anchored, except where specifically indicated otherwise; provide all anchors and fasteners required.

2.2 METAL STAIRS WITH CONCRETE TREADS (KEYNOTE: 055100-A)

- A. Jointing and Finish Quality Level: Architectural, as defined above.
- B. Risers: Closed.
- C. Treads: Metal pan with field-installed concrete fill.
 - 1. Concrete Depth: 1-1/2 inches, minimum.
 - 2. Tread Pan Material: Steel sheet.
 - 3. Tread Pan Thickness: As required by design; 14 gauge, 0.075 inch minimum.
 - 4. Concrete Reinforcement: Welded wire mesh.
 - 5. Concrete Finish: Steel troweled.
 - 6. Abrasive Strip: Contrasting color, applied to surface 1/2 inch back of point of nosing.
- D. Risers: Same material and thickness as tread pans.
 - 1. Riser/Nosing Profile: Sloped riser with rounded nosing of minimum radius.
 - 2. Nosing Depth: Not more than 1-1/2 inch overhang.
 - 3. Nosing Return: Flush with top of concrete fill, not more than 1/2 inch wide.
- E. Stringers: Rolled steel channels.
 - 1. Stringer Depth: 10 inches.
 - 2. End Closure: Sheet steel of same thickness as risers welded across ends.

- F. Landings: Same construction as treads, supported and reinforced as required to achieve design load capacity.
- G. Finish: Shop- or factory-prime painted.

2.3 HANDRAILS AND GUARDS

- A. Wall-Mounted Rails: See Section 05 52 13.
- B. Guards: Pipe railings, see Section 05 52 13.

2.4 MATERIALS

- A. Steel Sections: ASTM A 36/A 36M.
- B. Steel Tubing: ASTM A500/A500M or ASTM A501/A501M structural tubing, round and shapes as indicated.
- C. Steel Plates: ASTM A6/A6M or ASTM A283/A283M.
- D. Ungalvanized Steel Sheet: Hot- or cold-rolled, except use cold-rolled where finished work will be exposed to view.
 - 1. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Designation CS (commercial steel).
 - 2. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Designation CS (commercial steel).
- E. Concrete Reinforcement: Mesh type as detailed, galvanized.

2.5 ACCESSORIES

- A. Steel Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, and galvanized to ASTM A153/A153M where connecting galvanized components.
- B. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- C. Shop and Touch-Up Primer: SSPC-Paint 15, and comply with VOC limitations of authorities having jurisdiction.

2.6 SHOP FINISHING

- A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

- B. Do not prime surfaces in direct contact with concrete or where field welding is required.
- C. Prime Painting: Use specified shop- and touch-up primer.
 - 1. Preparation of Steel: In accordance with SSPC-SP 2 Hand Tool Cleaning.
 - 2. Number of Coats: One.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.2 PREPARATION

- A. When field welding is required, clean and strip primed steel items to bare metal.

3.3 INSTALLATION

- A. Install components plumb and level, accurately fitted, free from distortion or defects.
- B. Provide anchors, plates, angles, hangers, and struts required for connecting stairs to structure.
- C. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- D. Provide welded field joints where specifically indicated on drawings. Perform field welding in accordance with AWS D1.1/D1.1M.
- E. Other field joints may be either welded or bolted provided the result complies with the limitations specified for jointing quality levels.
- F. Obtain approval prior to site cutting or creating adjustments not scheduled.
- G. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.4 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

END OF SECTION 05 51 00

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SECTION 05 52 13 - PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wall mounted handrails.
- B. Stair railings and guardrails.

1.2 REFERENCE STANDARDS

- A. AISC 201 - AISC Certification Program for Structural Steel Fabricators, Standard for Steel Building Structures.
- B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- C. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- D. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
- E. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
 - 1. Include the design engineer's seal and signature on each sheet of shop drawings.
- B. Calculations: Signed and sealed by a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.

1.4 QUALITY ASSURANCE

- A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.

- B. Welder Qualifications: Show certification of welders employed on the Work, verifying AWS qualification within the previous 12 months.
- C. Fabricator Qualifications:
 - 1. A qualified steel fabricator that is certified by the American Institute for Steel Construction (AISC) under AISC 201.
 - 2. A company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

PART 2 PRODUCTS

2.1 RAILINGS - GENERAL REQUIREMENTS

- A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements applicable local code.
- B. Distributed Loads: Design railing assembly, wall rails, and attachments to resist distributed force of 75 pounds per linear foot applied to the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E 935.
- C. Concentrated Loads: Design railing assembly, wall rails, and attachments to resist a concentrated force of 200 pounds applied at any point on the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E 935.
- D. Allow for expansion and contraction of members and building movement without damage to connections or members.
- E. Dimensions: See drawings for configurations and heights.
- F. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
 - 1. For anchorage to stud walls, provide backing plates, for bolting anchors.
 - 2. Posts: Provide adjustable flanged brackets.
- G. Provide welding fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

2.2 STEEL RAILING SYSTEM

- A. Steel Tube: ASTM A500/A500M Grade B cold-formed structural tubing.
- B. Steel Pipe: ASTM A 53/A 53M Grade B Schedule 40, black finish.
- C. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.
- D. Exposed Fasteners: Flush countersunk screws or bolts; consistent with design of railing.
- E. Straight Splice Connectors: Steel concealed spigots.
- F. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.3 FABRICATION

- A. Accurately form components to suit specific project conditions and for proper connection to building structure.
- B. Fit and shop assemble components in largest practical sizes for delivery to site.
- C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.
- D. Welded Joints:
 - 1. Exterior Components: Continuously seal joined pieces by intermittent welds and plastic filler. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
 - 2. Interior Components: Continuously seal joined pieces by intermittent welds and plastic filler.
 - 3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.2 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply items required to be cast into concrete or embedded in masonry with setting templates, for installation as work of other sections.
- C. Apply one coat of bituminous paint to concealed aluminum surfaces that will be in contact with cementitious or dissimilar materials.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.
- C. Anchor railings securely to structure.
- D. Touch-up welds with primer. Grind welds smooth.
- E. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

3.4 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION 05 52 13

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Rough opening framing for doors, windows, and roof openings.
- B. Sheathing.
- C. Preservative treated wood materials.
- D. Fire retardant treated wood materials.
- E. Communications and electrical room mounting boards.
- F. Concealed wood blocking, nailers, and supports.

1.2 REFERENCE STANDARDS

- A. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
- B. ASTM D2898 - Standard Test Methods for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing.
- C. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- E. AWP A U1 - Use Category System: User Specification for Treated Wood.
- F. NELMA (SGR) - Standard Grading Rules for Northeastern Lumber.
- G. PS 1 - Structural Plywood.
- H. PS 20 - American Softwood Lumber Standard.
- I. SPIB (GR) - Grading Rules.
- J. WCLIB (GR) - Standard Grading Rules for West Coast Lumber No. 17.

K. WWPA G-5 - Western Lumber Grading Rules.

1.3 SUBMITTALS

A. Product Data: Provide technical data on insulated sheathing, wood preservative materials, and application instructions.

1.4 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
1. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
 2. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

2.2 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Grading Agency: Northeastern Lumber Manufacturers Association; NELMA (SGR).
- B. Grading Agency: Southern Pine Inspection Bureau, Inc; SPIB (GR).
- C. Grading Agency: West Coast Lumber Inspection Bureau; WCLIB (GR).
- D. Grading Agency: Western Wood Products Association; WWPA G-5.
- E. Sizes: Nominal sizes as indicated on drawings, S4S.

F. Moisture Content: S-dry or MC19.

G. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:

1. Lumber: S4S, No. 2.

2.3 CONSTRUCTION PANELS

A. Wall Sheathing, (KEYNOTE: 061000-F): APA Rated Plywood, PS 1, Grade C-D, Exposure I.

B. Wall Sheathing: Glass mat faced gypsum, ASTM C1177/C1177M, 1/2 inch.

1. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
2. Edges: Square.

C. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

D. Other Applications:

1. Plywood Concealed From View But Located Within Exterior Enclosure: APA Rated Plywood, PS 1, C-C Plugged or better, Exposure 1.
2. Plywood Exposed to View But Not Exposed to Weather: APA Rated Plywood, PS 1, A-D, or better.
3. Other Locations: APA Rated Plywood, PS 1, C-D Plugged or better.

2.4 ACCESSORIES

A. Fasteners and Anchors:

1. Metal and Finish: .
 - a. Electroplated complying with ASTM F1941, unless noted otherwise.
 - b. Hot-dipped galvanized steel complying with ASTM B695, Class 55 for fire retardant-treated wood locations.
 - c. Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations.

2.5 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWWA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
 - 1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
 - 2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWWA standards.
- B. Fire Retardant Treatment:
 - 1. Products:
 - a. Hoover Treated Wood Products, Inc: www.frtw.com/#sle.
 - b. Koppers, Inc: www.koppersperformancechemicals.com/#sle.
 - c. Viance, LLC: www.treatedwood.com/#sle.
 - 2. Exterior Type: AWWA U1, Category UCFB, Commodity Specification H, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes both before and after accelerated weathering test performed in accordance with ASTM D2898.
 - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
 - b. Treat exterior rough carpentry items.
 - c. Do not use treated wood in direct contact with the ground.
 - 3. Interior Type A: AWWA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.

- a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
- b. Interior rough carpentry items are to be fire retardant treated.
- c. Do not use treated wood in applications exposed to weather or where the wood may become wet.

C. Preservative Treatment:

1. Products:

- a. Koppers Performance Chemicals,
Inc: www.koppersperformancechemicals.com/#sle.
- b. Viance, LLC: www.treatedwood.com/#sle.

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.2 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to authorities having jurisdiction may be used in lieu of solid wood blocking.
- C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.

- D. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- E. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.
- F. Provide the following specific nonstructural framing and blocking:
 - 1. Cabinets and shelf supports.
 - 2. Grab bars.
 - 3. Towel and bath accessories.
 - 4. Wall-mounted door stops.
 - 5. Wall paneling and trim.
 - 6. Joints of rigid wall coverings that occur between studs.
 - 7. Other locations as indicated on drawings..

3.3 ROOF-RELATED CARPENTRY

- A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.
- B. Provide wood curb at each roof opening except where specifically indicated otherwise; form corners by alternating lapping side members.

3.4 INSTALLATION OF CONSTRUCTION PANELS

- A. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using screws.
 - 1. Fastening: #10 bugle head screws, 6" o.c. at panel edges, 12" o.c. at intermediate supports.
- B. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.

1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
3. Install adjacent boards without gaps.

3.5 TOLERANCES

- A. Framing Members: 1/4 inch from true position, maximum.
- B. Variation from Plane, Other than Floors: 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.6 CLEANING

- A. Waste Disposal: See Section 01 74 19 - Construction Waste Management and Disposal.
 1. Comply with applicable regulations.
 2. Do not burn scrap on project site.
 3. Do not burn scraps that have been pressure treated.
 4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.
- B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.
- C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION 06 10 00

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SECTION 06 41 00 - ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Specially fabricated cabinet units.
- B. Countertops.
- C. Hardware.

1.2 REFERENCE STANDARDS

- A. ANSI A208.2 - American National Standard for Medium Density Fiberboard for Interior Use.
- B. AWI (QCP) - Quality Certification Program.
- C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards.
- D. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0.
- E. BHMA A156.9 - American National Standard for Cabinet Hardware.
- F. NEMA LD 3 - High-Pressure Decorative Laminates.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.
 - 2. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
- B. Product Data: Provide data for hardware accessories.
- C. Samples: Submit actual samples of architectural cabinet construction, minimum 12 inches square, illustrating proposed cabinet, countertop, and shelf unit substrate and finish.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
 - 1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
- B. Quality Certification:
 - 1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.awiqcp.org/#sle.
 - 2. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
 - 3. Provide designated labels on shop drawings as required by certification program.
 - 4. Provide designated labels on installed products as required by certification program.
 - 5. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
 - 6. Replace, repair, or rework all work for which certification is refused.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from moisture damage.

1.6 FIELD CONDITIONS

- A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.1 CABINETS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

- B. Plastic Laminate Faced Cabinets (KEYNOTE: 064100-A): Custom grade.
- C. Cabinets at Office
 - 1. Finish - Exposed Exterior Surfaces: Decorative laminate.
 - a. Basis of Design: Formica Graystone Matte Texture or approved equal.
 - 2. Finish - Exposed Interior Surfaces: Decorative laminate.
 - a. Basis of Design: Formica Graystone Matte Texture or approved equal.
 - 3. Finish - Semi-Exposed Surfaces: Decorative laminate.
 - 4. Finish - Concealed Surfaces: Manufacturer's option.
 - 5. Countertop: Solid Surface:
 - a. Basis of Design: Corian Witch Hazel or approved equal.
 - 6. Door and Drawer Front Edge Profiles: Square edge with thin applied band.
 - 7. Casework Construction Type: Type B - Face-frame.
 - 8. Interface Style for Cabinet and Door: Style 1 - Overlay; reveal overlay.
 - 9. Grained Face Layout for Cabinet and Door Fronts: Flush panel.
 - a. Custom Grade: Doors, drawer fronts and false fronts wood grain to run and match vertically within each cabinet unit.
 - 10. Adjustable Shelf Loading: 50 psf.
 - 11. Cabinet Style: Flush overlay.
 - 12. Cabinet Doors and Drawer Fronts: Flush style.
- D. Cabinets at Reception Desk:
 - 1. Finish - Exposed Exterior Surfaces: Decorative laminate.
 - a. Basis of Design: Formica J0720 Nero or approved equal.
 - 2. Finish - Exposed Interior Surfaces: Decorative laminate.

- a. Basis of Design: Formica J0720 Nero or approved equal.
- 3. Finish - Semi-Exposed Surfaces: Decorative laminate.
- 4. Finish - Concealed Surfaces: Manufacturer's option.
- 5. Countertop: Solid Surface:
 - a. Basis of Design: Color 1: Corian Carbon Aggregate or Color 2: Corian Witch Hazel or approved equal.
- 6. Door and Drawer Front Edge Profiles: Square edge with thin applied band.
- 7. Door and Drawer Front Retention Profiles: Fixed panel.
- 8. Casework Construction Type: Type B - Face-frame.
- 9. Interface Style for Cabinet and Door: Style 1 - Overlay; reveal overlay.
- 10. Grained Face Layout for Cabinet and Door Fronts: Flush panel.
 - a. Custom Grade: Doors, drawer fronts and false fronts wood grain to run and match vertically within each cabinet unit.
- 11. Adjustable Shelf Loading: 50 psf.
- 12. Cabinet Style: Flush overlay.
- 13. Cabinet Doors and Drawer Fronts: Flush style.
- 14. Drawer Side Construction: Multiple-dovetailed.
- 15. Drawer Construction Technique: Dovetail joints.

2.2 WOOD-BASED COMPONENTS

- A. Wood fabricated from old growth timber is not permitted.
- B. Hardwood Edgebanding: Use solid hardwood edgebanding matching species, color, grain, and grade for exposed portions of cabinetry.

2.3 PANEL CORE MATERIALS

- A. Plywood not exposed to view,

- B. Medium Density Fiberboard (MDF): Composite panel composed of cellulosic fibers, additives, and bonding system; cured under heat and pressure; comply with ANSI A208.2.

2.4 LAMINATE MATERIALS

A. Manufacturers:

1. Formica Corporation: www.formica.com/#sle.
2. Panolam Industries International, Inc: www.panolam.com/#sle.
3. Wilsonart LLC: www.wilsonart.com/#sle.

- B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.

C. Provide specific types as indicated.

1. Horizontal Surfaces: HGS, 0.048 inch nominal thickness, through color, color as selected, finish as selected.
2. Vertical Surfaces: VGS, 0.028 inch nominal thickness, through color, color as selected, finish as selected.
3. Post-Formed Horizontal Surfaces: HGP, 0.039 inch nominal thickness, through color, color as selected, finish as indicated.
4. Post-Formed Vertical Surfaces: VGP, 0.028 inch nominal thickness, through color, color as selected, finish as indicated.
5. Cabinet Liner: CLS, 0.020 inch nominal thickness, through color, color as selected, finish as indicated.
6. Laminate Backer: BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

2.5 COUNTERTOPS

- A. Solid surface Countertops (KEYNOTE:064100-C and 064100-D) Solid surfacing sheet or plastic resin casting over continuous substrate.

1. Flat Sheet thickness: 1/2 inch minimum
2. Solid Surfacing Shet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
 - a. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84
 - b. Finish on Exposed Surfaces: Semi-gloss, gloss rating of 25 to 50.
 - c. Color and Pattern: As indicated above.
3. Other Components Thickness: 1/2 inch minimum
4. Exposed Edge Treatment: Built up to minimum 1-1/4 in thick; edge profile as indicated on the drawings.
5. Back and End Splashes: Same sheet material, square top; minimum 4 inches high
6. Fabricate in accordance with manufacturer's standard requirements.

2.6 ACCESSORIES

- A. Adhesive: Type recommended by fabricator to suit application.
- B. Fasteners: Size and type to suit application.
- C. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
- D. Concealed Joint Fasteners: Threaded steel.
- E. Adjustable Drawer Organization Systems: Drawer trays, dividers, and connectors.
- F. Grommets (KEYNOTE: 064100-N) : Standard plastic grommets for cut-outs, in color to match adjacent surface.

2.7 HARDWARE

- A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.
- B. Metal Z-Shaped Wall Cabinet Support Clips: Paired, cleated, structural anchorage components applied to back of cabinets and walls for wall cabinet mounting.
- C. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards or multiple holes for pin supports and coordinated self rests, polished chrome finish, for nominal 1 inch spacing adjustments.
- D. Countertop Support Brackets (KEYNOTE: 064100-M): Fixed, L-shaped, face-of-stud mounting.
 - 1. Materials: Steel; T-shape cross-section.
 - a. Finish: Manufacturer's standard, factory-applied, powder coat.
 - b. Color: Black.
- E. Drawer and Door Pulls: "U" shaped wire pull, steel with satin finish, 4 inch centers.
- F. Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with chrome finish. Provide locks at all cabinets.
- G. Cabinet Catches and Latches:
 - 1. Type: Push latch.
- H. Drawer Slides:
 - 1. Type: Full extension with overtravel.
 - 2. Static Load Capacity: Heavy Duty grade.
 - 3. Mounting: Bottom mounted.
 - 4. Stops: Integral type.
 - 5. Features: Provide self closing/stay closed type.
- I. Drawer Systems: Integrated drawers and slides.

1. Side Type: Single wall.
2. Extension Type: Full extension.
3. Mounting: Side mounted.
4. Stops: Integral type.

J. Hinges: European style concealed self-closing type, steel with satin finish.

2.8 FABRICATION

- A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
- D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.
 1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
 2. Cap exposed plastic laminate finish edges with material of same finish and pattern.
- E. Matching Wood Grain: Comply with requirements of quality standard for specified Grade and as follows:
 1. Provide sequence matching across each elevation.
- F. Mechanically fasten back splash to countertops as recommended by laminate manufacturer at 16 inches on center.
- G. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.
- H. Solid Surfacing: Fabricate tops up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.

2.9 SHOP FINISHING

- A. Sand work smooth and set exposed nails and screws.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify adequacy of backing and support framing.

3.2 INSTALLATION

- A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.
- B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- C. Use fixture attachments in concealed locations for wall mounted components.
- D. Use concealed joint fasteners to align and secure adjoining cabinet units.
- E. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
- F. Secure cabinets to floor using appropriate angles and anchorages.
- G. Seal joint between back/end splashes and vertical surfaces.
- H. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.
- I. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.

3.3 ADJUSTING

- A. Adjust installed work.
- B. Adjust moving or operating parts to function smoothly and correctly.

3.4 CLEANING

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION 06 41 00

SECTION 07 13 00 - SHEET WATERPROOFING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Self-adhered sheet membrane waterproofing.

1.2 REFERENCE STANDARDS

- A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension.
- B. ASTM D570 - Standard Test Method for Water Absorption of Plastics.
- C. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
- D. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
- E. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
- F. ASTM D5295/D5295M - Standard Guide for Preparation of Concrete Surfaces for Adhered (Bonded) Membrane Waterproofing Systems.
- G. ASTM D5385/D5385M - Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes.
- H. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.
- I. NRCA (WM) - The NRCA Waterproofing Manual.

1.3 SUBMITTALS

- A. Product Data: Provide data for membrane.
- B. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.
- C. Manufacturer's Installation Instructions: Indicate special procedures.

- D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience and approved by manufacturer.

1.5 MOCK-UPS

- A. Construct mock-up consisting of 100 sq ft of horizontal and vertical sheet waterproofing panel; to represent finished work including internal and external corners, seam jointing, and attachment method.
- B. Locate where directed.
- C. Mock-up may remain as part of work.

1.6 FIELD CONDITIONS

- A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until liquid or mastic accessories have cured.

1.7 WARRANTY

- A. Contractor to correct defective Work within period of five years after Date of Substantial Completion; remove and replace materials concealing waterproofing at no extra cost to Owner.
- B. Provide five year manufacturer warranty for waterproofing failing to resist penetration of water, except where such failures are the result of structural failures of building. Hairline cracking of concrete due to temperature change or shrinkage is not considered a structural failure.

PART 2 PRODUCTS

2.1 SHEET WATERPROOFING APPLICATIONS

- A. Self-Adhered Modified Bituminous Sheet Membrane:

1. Location: Below grade applications as shown on drawings.
2. Cover with Rigid insulation with drainage board per wall type designation.

2.2 SHEET WATERPROOFING MATERIALS

A. Self-Adhered Modified Bituminous Sheet Membrane (KEYNOTE 071300-A):

1. Thickness: 60 mil, 0.060 inch, minimum.
2. Sheet Width: 36 inches, minimum.
3. Tensile Strength:
 - a. Film: 5,000 psi, minimum, measured in accordance with ASTM D882 and at grip-separation rate of 2 inches per minute.
 - b. Membrane: 325 psi, minimum, measured in accordance with ASTM D412 Method A, using die C and at spindle-separation rate of 2 inches per minute.
4. Elongation at Break: 300 percent, minimum, measured in accordance with ASTM D412.
5. Water Vapor Permeance: 0.05 perm, maximum, measured in accordance with ASTM E96/E96M.
6. Low Temperature Flexibility: Unaffected when tested in accordance with ASTM D1970/D1970M at minus 20 degrees F, 180 degree bend on 1 inch mandrel.
7. Adhesion: 150 psi, minimum, measured in accordance with ASTM D4541.
8. Water Absorption: 0.1 percent increase in weight, maximum, measured in accordance with ASTM D570, 24 hour immersion.
9. Hydrostatic Pressure Resistance: Membrane resists leakage for at least one hour from pressure equivalent to 200 feet head of water applied in accordance with test method ASTM D5385/D5385M.
10. Adhesives, Sealants, Tapes, and Accessories: As recommended by membrane manufacturer.
11. Products:

- a. Carlisle Coatings & Waterproofing Inc; MiraDRI
860/861: www.carlisleccw.com/#sle.
- b. Henry Company; Blueskin WP 200: www.henry.com/#sle.
- c. W.R. Meadows, Inc; MEL-ROL: www.wrmeadows.com/#sle.
- d. Or Equal.

2.3 ACCESSORIES

- A. Primer: As recommended by membrane manufacturer.
- B. Seaming Materials: As recommended by membrane manufacturer.
- C. Membrane Sealant: As recommended by membrane manufacturer.
- D. Sealant for Cracks and Joints In Substrates: Resilient elastomeric joint sealant compatible with substrates and waterproofing materials.
- E. Protection Board: Provide type capable of preventing damage to waterproofing due to backfilling and construction traffic.
 - 1. Polystyrene foam board, 3/8 inch thick, as recommended by manufacturer.
- F. Cant Strips: Premolded composition material.
- G. Flexible Flashings: Type recommended by membrane manufacturer.
- H. Termination Bars: Stainless steel; compatible with membrane and adhesives.
- I. Surface Conditioner: Pure Sodium Silicate type, compatible with membrane.
- J. Adhesives: As recommended by membrane manufacturer.
- K. Thinner and Cleaner: As recommended by adhesive manufacturer, compatible with sheet membrane.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions are acceptable prior to starting work.

- B. Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of waterproofing system.
- C. Verify that items penetrating surfaces to receive waterproofing are securely installed.
- D. Where existing conditions are responsibility of another installer, notify Architect of unsatisfactory conditions.
- E. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protect adjacent surfaces from damage not designated to receive waterproofing.
- B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions; vacuum substrate clean.
- C. Do not apply waterproofing to surfaces unacceptable to membrane manufacturer.
- D. Fill nonmoving joints and cracks with a filler compatible with waterproofing materials.
- E. Seal moving cracks with sealant and nonrigid filler, using procedures recommended by sealant and waterproofing manufacturers.
- F. Prepare building expansion joints at locations as indicated on drawings.
- G. Surfaces for Adhesive Bonding: Apply surface conditioner at a rate recommended by manufacturer, and protect conditioner from rain or frost until dry.
- H. Concrete Surfaces for Adhesive Bonding: Prepare concrete substrate in accordance with ASTM D5295/D5295M.
 - 1. Remove substances that inhibit adhesion including form release agents, curing compounds admixtures, laitance, moisture, dust, dirt, grease and oil.
 - 2. Repair surface defects including honeycombs, fins, tie holes, bug holes, sharp offsets, rutted cracks, ragged corners, deviations in surface plane, spalling and delaminations, as described in reference standard.
 - 3. Remove and replace areas of defective concrete; see Section 03 30 00.
 - 4. Prepare concrete for adhesive bonded waterproofing using mechanical or chemical methods described in referenced standard.

5. Test concrete surfaces as described in referenced standards, and verify surfaces are ready to receive adhesive bonded waterproofing membrane system.

3.3 INSTALLATION - MEMBRANE

- A. Install membrane waterproofing in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.
- B. Roll out membrane, and minimize wrinkles and bubbles.
- C. Self-Adhering Membrane: Remove release paper layer, and roll out onto substrate with a mechanical roller to provide full contact bond.
- D. Overlap edges and ends, minimum 3 inches, seal permanently waterproof by method recommended by manufacturer, and apply uniform bead of sealant to joint edge.
- E. Reinforce membrane with multiple thickness of membrane material over joints, whether joints are static or dynamic.
- F. Weather lap joints on sloped substrate in direction of drainage, and seal joints and seams.
- G. Install building expansion joints at locations as indicated on drawings.
- H. Flexible Flashings: Seal items watertight that penetrate through waterproofing membrane with flexible flashings.
- I. Seal membrane and flashings to adjoining surfaces.
 1. Install termination bar along edges.
 2. Install counterflashing over exposed edges.

3.4 INSTALLATION - PROTECTION BOARD

- A. Place protection board directly against membrane; butt joints, and scribe and cut boards around projections, penetrations, and interruptions.
- B. Adhere protection board to substrate with compatible adhesive.

3.5 FIELD QUALITY CONTROL

- A. Engage a site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components, and to furnish daily reports to Architect.
- B. Prepare test and inspection reports.

3.6 PROTECTION

- A. Do not permit traffic over unprotected or uncovered membrane.

END OF SECTION 07 13 00

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SECTION 07 21 00 - THERMAL INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Board insulation at cavity wall construction, perimeter foundation wall, over roof deck, and exterior wall behind concrete wall finish.
- B. Batt insulation in exterior wall construction.
- C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.2 REFERENCE STANDARDS

- A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
- B. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- C. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- E. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.
- F. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C.
- G. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.

1.3 SUBMITTALS

- A. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

- B. ABAA Field Quality Control Submittals: Submit third-party reports of testing and inspection required by ABAA QAP.
- C. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.
- D. ABAA Installer Qualification: Submit documentation of current contractor accreditation and current installer certification. Keep copies of contractor accreditation and installer certification on project site during and after installation. Present on-site documentation upon request.

1.4 QUALITY ASSURANCE

- A. Air Barrier Association of America (ABAA) Quality Assurance Program (QAP); www.airbarrier.org/#sle:
 - 1. Installer Qualification: Use accredited contractors, certified installers, evaluated materials, and third-party field quality control audit.
 - 2. Manufacturer Qualification: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.

1.5 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.1 APPLICATIONS

- A. Insulation at Perimeter of Foundation: Extruded polystyrene (XPS) board.
- B. Insulation Over Metal Stud Framed Walls: Polyisocyanurate board.
- C. Insulation on Inside of Concrete and Masonry Exterior Walls: Polyisocyanurate board.
- D. Insulation in Metal Framed Walls: Batt insulation with no vapor retarder.

2.2 FOAM BOARD INSULATION MATERIALS

- A. Extruded Polystyrene (XPS) Board Insulation (KEYNOTE: 072100-J): Comply with ASTM C578 with either natural skin or cut cell surfaces.
 - 1. Perimeter of Foundations, at Concrete & CMU Walls, Type and Compressive Resistance: Type IV, 25 psi (173 kPa), minimum.
 - 2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
 - 3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
 - 4. Type and Thermal Resistance, R-value: Type IV, 5.0 (0.88), minimum, per 1 inch thickness at 75 degrees F mean temperature.
 - 5. Type and Thermal Resistance, R-value: minimum 5.0 (0.88), minimum, per 1 inch thickness at 75 degrees F mean temperature.
- B. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches (1:48) unless otherwise indicated.
 - 1. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.
- C. Polyisocyanurate (ISO) Board Insulation within cast-in-place concrete walls (KEYNOTE: 072100-C): Rigid cellular foam, comply with ASTM C1289.
 - 1. Classifications:
 - a. Type II: Faced with glass fiber mat facers on both major surfaces of the core foam.
 - 1) Class 2 - Faced with coated glass fiber mat facers on both major surfaces of core foam.
 - 2) Compressive Strength: Classes 1-2-3, Grade 3 - 25 psi (172 kPa), minimum.
 - 3) Thermal Resistance, R-value: At 1-1/2 inch thick; Class 1, Grades 1-2-3 - 8.4 (1.48), minimum, at 75 degrees F.

2. Flame Spread Index (FSI): Class B - 26 to 75, when tested in accordance with ASTM E84.
 3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
 4. Water Vapor Permeance: 1.2 perm, maximum, at 1 inch thickness, and when tested in accordance with ASTM E96/E96M, desiccant method.
 5. Comply with fire resistance requirements specified as part of an exterior wall assembly when tested in accordance with NFPA 285.
 6. Board Size: 48 inch by 96 inch.
 7. Board Thickness: 2.0 inch.
- D. Rigid Cellular Polyisocyanurate (ISO) Thermal Insulation Board behind Metal Panel Walls, with Facers Both Sides (KEYNOTE: 072100-C): Complying with ASTM C1289.
1. Classifications:
 - a. Type II: Faced with either cellulosic facers or glass fiber mat facers on both major surfaces of the core foam.
 - 1) Class 2 - Faced with coated glass fiber mat facers on both major surfaces of the core foam.
 - 2) Compressive Strength: Classes 1-2-3, Grade 1 - 16 psi (110 kPa), minimum.
 - 3) Thermal Resistance, R-value: At 1-1/2 inch thick; Class 1, Grades 1-2-3 - 8.4 (1.48), minimum, at 75 degrees F.
 2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
 3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.

4. Comply with fire resistance requirements indicated on drawings as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.
5. Board Size: 48 inch by 96 inch.
6. Board Thickness: 2.5 inch.
7. Board Edges: Square.

2.3 MINERAL FIBER BLANKET INSULATION MATERIALS

- A. Flexible Glass Fiber Blanket Thermal Insulation (KEYNOTE: 072100-B): Preformed insulation, complying with ASTM C665; friction fit.
 1. Flame Spread Index: 75 or less, when tested in accordance with ASTM E84.
 2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 3. Combustibility: Non-combustible, when tested in accordance with ASTM E136.
 4. Formaldehyde Content: Zero.
- B. Mineral Wool Blanket Thermal Insulation (KEYNOTE: 072100-E): Flexible or semi-rigid preformed insulation, complying with ASTM C665.
 1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 2. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.

2.4 ACCESSORIES

- A. Self-Adhered Transition Flashing (KEYNOTE: 072100-H): Multipurpose, self-adhered flashing with modified butyl adhesive, polyester fiber top sheet, and polypropylene interlayer.
 1. Application: Primerless adhesion for use as through-wall flashings and wall transitions to roof and below-grade systems.
 2. Thickness: 45 mil, 0.045 inch, nominal.
 3. Size: 6 inches wide, in rolls 75 feet long.
- B. Flashing Tape: Special reinforced film with high performance adhesive.

1. Application: Window and door opening flashing tape.
 2. Width: As required for application.
 3. Primer: Tape manufacturer's recommended product.
- C. Tape joints of rigid insulation in accordance with insulation manufacturers' instructions.
- D. Insulation Fasteners: Appropriate for purpose intended at cast-in-place concrete walls.
1. Length as required for thickness of insulation material and penetration of substrate, and designed to hold insulation in place between concrete wall formwork.
- E. Adhesive: Type recommended by insulation manufacturer for application.
- F. Z-Furring Channel (KEYNOTE: 072100-G):
1. Depth: As shown on drawings.
 2. Gauge: 20 gauge galvanized steel.
 3. Coating: G60
- G. Light Gauge Closure Angle (KEYNOTE: 072100-L)
1. Sizes: As shown on drawings.
 2. Gauge 25 gauge galvanized steel.
 3. Coating: G60
 4. Basis of Design: L-Angle; Clark Dietrich Building Systems or approved equal.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation and adhesive.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.2 BOARD INSTALLATION AT FOUNDATION PERIMETER

- A. Apply adhesive to back of boards: Per manufacturer's recommendations.
- B. Install boards horizontally on foundation perimeter.
 - 1. Place boards to maximize adhesive contact.
 - 2. Install in running bond pattern.
 - 3. Butt edges and ends tightly to adjacent boards and to protrusions.
- C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.3 BOARD INSTALLATION AT EXTERIOR WALLS

- A. Apply adhesive to back of boards: Per manufacturer's recommendations.
- B. Install boards horizontally on walls.
 - 1. Place boards to maximize adhesive contact.
 - 2. Install in running bond pattern.
 - 3. Butt edges and ends tightly to adjacent boards and protrusions.
- C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
- D. Tape insulation board joints.

3.4 BOARD INSTALLATION AT CAVITY WALLS

- A. Apply adhesive to back of boards: Per manufacturer's recommendations.
- B. Install boards to fit snugly between wall ties.
- C. Install boards horizontally on walls.
 - 1. Place boards to maximize adhesive contact.
 - 2. Install in running bond pattern.
 - 3. Butt edges and ends tightly to adjacent boards and protrusions.
 - 4. Place impale fastener locking discs.

- D. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.5 BOARD INSTALLATION OVER LOW SLOPE ROOF DECK

A. Board Installation Over Roof Deck, General:

1. See applicable roofing specification section for specific board installation requirements.
2. Fasten insulation to deck in accordance with roofing manufacturer's written instructions and applicable Factory Mutual requirements.
3. Do not apply more insulation than can be covered with roofing on the same day.

3.6 BATT INSTALLATION

- A. Install insulation in accordance with manufacturer's instructions.
- B. Install in exterior wall and roof spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.
- E. Tape seal butt ends, lapped flanges, and tears or cuts in membrane.

3.7 PROTECTION

- A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION 07 21 00

SECTION 07 27 00 - AIR BARRIERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Air barriers.

1.2 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.
- C. ASTM E2178 - Standard Test Method for Air Permeance of Building Materials.

1.3 SUBMITTALS

- A. Product Data: Provide data on material characteristics, performance criteria, and limitations.
- B. Shop Drawings: Provide drawings of special joint conditions.

PART 2 PRODUCTS

2.1 AIR BARRIER MATERIALS (AIR IMPERMEABLE AND WATER VAPOR PERMEABLE)(KEYNOTE: 072700-A)

- A. Air Barrier Sheet, Self-Adhered:
 - 1. Air Permeance: 0.004 cfm/sq ft, maximum, when tested in accordance with ASTM E2178.
 - 2. Water Vapor Permeance: 10 perms, minimum, when tested in accordance with ASTM E96/E96M using Procedure A - Desiccant Method, at 73.4 degrees F.
 - 3. Ultraviolet (UV) and Weathering Resistance: Approved by manufacturer for up to 90 days of weather exposure.

4. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A when tested in accordance with ASTM E84.
5. Seam and Perimeter Tape: As recommended by sheet manufacturer.
6. Products:
 - a. Henry Company; Blueskin VP160: www.henry.com/#sle.
 - b. Or Equal.

2.2 AIR BARRIER MATERIALS (AIR IMPERMEABLE AND WATER VAPOR IMPERMEABLE)(KEYNOTE: 072700-B)

A. Air and Vapor Barrier Sheet, Self-Adhered:

1. Air Permeance: 0.004 cfm/sq ft, maximum, when tested in accordance with ASTM E2178.
2. Water Vapor Permeance: 1.0 perms, maximum, when tested in accordance with ASTM E96/E96M using Procedure B - Water Method.
3. Products:
 - a. Henry Company; Blueskin SA: www.henry.com..
 - b. Or equal.

2.3 ACCESSORIES

- A. Sealants, Tapes, and Accessories for Sealing Air Barrier and Adjacent Substrates: As indicated or in compliance with air barrier manufacturer's installation instructions.
- B. Primer: As recommended by membrane manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces and conditions are ready for work of this section.
- B. Where existing conditions are responsibility of another installer, notify Architect of unsatisfactory conditions.

- C. Do not proceed with this work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.
- B. Clean and prime substrate surfaces to receive adhesives and sealants in accordance with manufacturer's installation instructions.

3.3 INSTALLATION

- A. Install materials in accordance with manufacturer's installation instructions.
- B. Air Barriers: Install continuous airtight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.
- C. Apply sealants and adhesives within recommended temperature range in accordance with manufacturer's installation instructions.
- D. Self-Adhered Sheets:
 - 1. Prepare substrate in accordance with sheet manufacturer's installation instructions; fill and tape joints in substrate and between dissimilar materials.
 - 2. Lap sheets shingle fashion to shed water and seal laps airtight.
 - 3. Once sheets are in place, press firmly into substrate with resilient hand roller; ensure that laps are firmly adhered with no gaps or fishmouths.
 - 4. Use same material, or other material approved by sheet manufacturer, to seal to adjacent substrates, and as flashing.
 - 5. At wide joints, provide extra flexible membrane allowing joint movement.
- E. Openings and Penetrations in Exterior Air Barriers:
 - 1. Install flashing over sills, covering entire sill frame member, extending at least 5 inches onto air barrier and at least 6 inches up jambs; mechanically fasten stretched edges.

2. At openings with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches wide; do not seal sill flange.
3. At openings with nonflanged frames, seal air barrier to each side of framing at opening using flashing at least 9 inches wide, and covering entire depth of framing.
4. At head of openings, install flashing under air barrier extending at least 2 inches beyond face of jambs; seal air barrier to flashing.
5. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.
6. Service and Other Penetrations: Form flashing around penetrating item and seal to air barrier surface.

3.4 FIELD QUALITY CONTROL

A. Coordination of ABAA Tests and Inspections:

1. Provide testing and inspection required by ABAA QAP.
2. Notify ABAA in writing of schedule for air barrier work, and allow adequate time for testing and inspection.
3. Cooperate with ABAA testing agency.
4. Allow access to air barrier work areas and staging.
5. Do not cover air barrier work until tested, inspected, and accepted.

B. Do not cover installed air barriers until required inspections have been completed.

3.5 PROTECTION

A. Do not leave materials exposed to weather longer than recommended by manufacturer.

END OF SECTION 07 27 00

SECTION 07 33 63 - VEGETATED ROOF ASSEMBLY: PRE-VEGETATED MODULAR

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pre-vegetated modular vegetated roof assembly components.
2. Vegetated roof growing media.
3. Vegetated roof planting material.
4. Vegetation-free zone material.

1.2 DEFINITIONS

- A. Vegetated Roof Assembly:** Rooftop assembly, to form continuous cover over designed roofing area, composed of single-media system, that is designed to grow plants and to retain and retard rainwater runoff from the roof.

1. **Pre-vegetated Modular Vegetated Roof Assembly:** Landscape built using an assembly that is modular, consisting of the following fully integrated living and manufactured components:
 - a. Electronic leak detection.
 - b. Technical seam tapes.
 - c. Protection sheet.
 - d. Horizontal insulation.
 - e. Drain inspection box.
 - f. Pre-vegetated modular tray.
 - g. Edging restraint.
 - h. Pre-cast concrete pavers and Loose aggregate.
 - i. Irrigation.

- B. Captured Water: Water that is retained in the drainage layer of a vegetated roof assembly after new water additions have ceased and that cannot escape the roof except through evaporation or plant transpiration.
- C. Planted Area; Vegetated Area: Areas to be planted.
- D. Vegetation-Free Zone: Areas without plantings.
- E. Plant; Plants; Plant Material: Vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.
- F. Alive: Displaying horticultural viability consisting of vigorous, hardy, and sustainable growth characteristics.
- G. Retained Water: Water that is held for a period of hours or days but would eventually drain out given enough time in the absence of evaporation or plant transpiration.

1.3 ACTION SUBMITTALS

- A. Submittals in accordance with Section 01 33 00 “Submittal Procedures”.
- B. Product Data: For each of the components of vegetated roof assembly indicated, including the following:
 - 1. Root barrier and barrier seam tape.
 - 2. Protection sheet.
 - 3. Horizontal insulation.
 - 4. Drain inspection box.
 - 5. Pre-vegetated modular tray.
 - 6. Edging restraint.
 - 7. Pre-cast concrete pavers and Loose aggregate.
 - 8. Erosion control netting.
 - 9. Irrigation.

- C. Shop Drawings: For vegetated roof assemblies. Include roof plans, slopes, and drain locations; details of vegetated roof assemblies and accessories, walkway pavers, and aggregate surfacing.
 - 1. Indicate planted areas correlated with planting schedule.
 - 2. Coordinate with requirements for membrane leak detection system.

1.4 INFORMATIONAL SUBMITTALS

- A. Installer's Certificate: For vegetated roof assembly Installer and irrigation system Installer, verifying qualifications on company letterhead.
- B. Manufacturer's Certificate: For specified products of vegetated roof assembly, signed by Manufacturer, verifying approval of Installer.
- C. Product Testing Data: Based on evaluation of comprehensive tests conducted on specified products by the following independent testing agencies:
 - 1. Test reports from a certified laboratory for ASTM E 2399-05: For growing media, tested within current twelve (12) month period.
- D. Manufacturer Field Inspection Reports: Manufacturer's written reports and acceptance of vegetated roof assembly Installer based on regular inspections. Include weather conditions, description of work performed, tests performed, defective work observed, and corrective actions taken to correct defective work.
- E. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Recommended maintenance plan including procedures for inspection and care of vegetated roof assembly and plants during a calendar year. Submit before start of required warranty and maintenance periods.
- B. Maintenance Reports: Reports of vegetated roof assembly Inspector submitted quarterly. Must be signed by approved representation of vegetated roof assembly Installer, must outline actions carried out as per Maintenance Requirements.

1.6 QUALITY ASSURANCE

- A. Vegetated Roof Assembly Installer Qualifications: A qualified Installer, certified by vegetated roof assembly Manufacturer, whose work has resulted in successful establishment of plants.
 - 1. Experience: Three years' proven experience in vegetated roof assembly installation in addition to requirements in Section 01 40 00 "Quality Requirements."
 - 2. Training: Staff trained to facilitate maintenance of vegetated roof assembly.
 - 3. Fall Protection: Fall Arrest Certificates maintained by all employees of Installer when working on roof top.
 - 4. Installer's Field Supervision: Maintain experienced full-time supervisor on Project site when work is in progress.
- B. Vegetated Roof Assembly Manufacturer Qualifications: A qualified company, specialized in supplying vegetated roof assembly systems.
 - 1. Experience: Five years' experience in supplying vegetated roof assemblies.
- C. Source Limitations: Obtain vegetated roof assembly components and roof membrane specified in Division 07 roofing membrane section from single source from single manufacturer.
- D. Electronic Testing: Perform leak testing by installation of Electro Field Vector Mapping (EFVM) system administered by a qualified testing agency. Flood testing is unacceptable as a testing procedure.
- E. Health and safety: Perform in accordance to Health and Safety Requirements.
- F. Pre-Installation Conference: Conduct conference at Project site one week prior to beginning work of this Section and on-site installations.
 - 1. Coordinate: Requirements and procedures related to roof deck and roofing system construction:
 - a. Participants: Architect, authorized representatives of Contractor, Construction Manager, Owner, Consultant, Roofing Subcontractor, Roofing Manufacturer, vegetated roof assembly Manufacturer, vegetated roof assembly Installer.

- b. Vegetated Roof Assembly: Review methods and procedures, including Manufacturer's written installation instructions.
- c. Construction Schedule: Review and confirm availability of products, Subcontractor personnel, equipment, and facilities.
- d. Conformance: Review roofing membrane type and vegetated roof assembly criteria.
- e. Structural Load: Review limitations of roof deck, identifying loading areas for storage. Obtain structural report from Consultant certifying dead load weight restrictions for entire assembly.
- f. Roof Details: Review flashing, drains, penetrations, equipment curbs, and other conditions.
- g. Regulations: Review, including necessary insurance and/or certificates.
- h. Safety: Review requirements, including Fall Protection requirements.
- i. Quality Control: Review procedures and policy.
- j. EFVM: Obtain report certifying roof is watertight.
- k. Coordinate: related work specified in other Sections.
- l. Inspection: Review Manufacturer's procedure for warranty.
- m. On-site traffic: Review limits by other trades on vegetated roof assembly and procedures for compensation due to damage.
- n. Meeting minutes: Taken by representative of Consultant and distributed to all parties within 24 hours of meeting date.
- o. Photographic records: Taken by Contractor prior to commencement of Work.

1.7 PROJECT FIELD CONDITIONS

- A. Product Handling: Deliver and store products in original packaging with Manufacturer's labels and materials list intact and signed off, elevated from ground and protected from environmental damage within designated weather protected areas. Avoid storage of products on site to prevent contamination.

- B. Pre-vegetated Modular Tray Handling: Install pre-vegetated modules immediately upon delivery to site.
- C. Installation:
 - 1. Pre-vegetated Modular Tray: According to optimal conditions, conducive to plant establishment and survival based upon local hardiness zone as defined by USDA.
 - 2. All other components of vegetated roof assembly: At any time, adequate protection should be provided to prevent damage and erosion.
- D. Foot Traffic: Prohibited on vegetated roof assembly during vegetation establishment period and thereafter except for vegetated roof maintenance purposes.

1.8 WARRANTIES

- A. Roof System Warranty, General: Warranties specified in this Section are components of the roofing system warranty specified in other sections supplied by the roofing system Manufacturer, and installed by the roofing system Installer:
 - 1. Refer to Division 07 roofing membrane section for roofing system warranty and continuing maintenance service requirements, including warranty requirements of other specification sections referenced in roofing system warranty.
- B. Special Warranty for Vegetated Roof Assembly: Provide manufacturer's standard warranty in which Manufacturer and Installer jointly agree to repair or replace vegetated roof assembly and components, including root barrier, membrane protection sheet, percolation/retention and drainage layer, geotextile filter fabric layers, horizontal insulation, and engineered growing media, and excluding plant materials covered under separate warranty below, that fail in materials or workmanship within specified warranty period.
 - 1. Failure includes, but is not limited to, ponding water or prolonged wetness of growing media caused as a result of failure of the assembly to properly drain.
 - 2. Manufacturer's warranty applies to Projects installed by Manufacturer-approved Installer and inspected by Manufacturer Technical Representative.
 - 3. Warranty Period: 25 years from date of Substantial Completion.

- C. Special Warranty for Plant Growth: Provide manufacturer's standard warranty in which Manufacturer and Installer jointly agree to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
1. Groundcover Foliage Cover: Plantings shall grow to achieve and maintain at least 85 percent foliage cover over planting area, when averaged within 2 square foot increments, commencing with installation, at the end of the warranty period. Provide extended warranty for remainder of original warranty period for replaced plant material.
 2. Herbaceous Perennials, Ornamental Grasses, and Vines: Plantings shall grow to achieve and maintain at least 75 percent horticultural viability over planting area commencing with installation, through the duration of this warranty. A limit of one replacement of each plant will be required except for losses or replacements due to failure to comply with requirements.
 3. Failures include, but are not limited to, death and unsatisfactory growth of plant materials except for defects resulting from abuse, neglect by Owner, or incidents that are beyond Contractor's control.
 4. Warranty Periods from Date of Installation:
 - a. Ground Covers: Two years.
 - b. Herbaceous Perennials, Ornamental Grasses, and Vines: Two years.
 - c. Woody Plants and Shrubs: Two years.

1.9 MAINTENANCE SERVICE

- A. Initial Maintenance Service for Plant Materials: Provide maintenance and general housekeeping of vegetated roof assembly by competent employees of vegetated roof assembly Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than the following maintenance period:
1. Site Visits: Provide not less than three site visits per year to perform required tasks under this Service. Provide one site visit during Year Two by a qualified Manufacturer's representative.

2. Growing Media Testing and Amending: Perform testing during second year of initial maintenance period and apply amendments to growing media as required. Comply with local watershed authority stormwater nutrient run-off restrictions.
 3. Include the following remedial actions as a minimum:
 - a. During inspection, 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. Trim plants and remove weeds. Provide supplemental water if required at time of inspection and service.
 - c. Reports: Provide written report to Owner including health assessment of plant material and growing media and indication of work performed with each site visit.
 4. Initial Maintenance Period: Equal to warranty period under "Special Warranty for Plant Growth" Paragraph above.
- B. Continuing Maintenance Service: Provide maintenance and general housekeeping of vegetated roof assembly by competent employees of vegetated roof assembly Installer. Manufacturer's standard continuing maintenance agreement, commencing on date initial maintenance service under warranty is concluded. Include the following:
1. Site Visits: Provide not less than three site visits per year to perform required tasks under this Service.
 2. Growing Media Testing and Amending: Perform testing annually and apply amendments as required.
 3. Supplemental Water: Add supplemental water as required to bring growing media up to recommended moisture content levels. Inform Owner of recommended adjustment to Owner's watering practices.
 4. Weeding and Plant Material Housekeeping: Remove dead and damaged growth and weeds and debris. Dispose of debris onsite in Owner's container.
 5. General Housekeeping: Perform general rooftop housekeeping in accordance with requirements in Division 07 roofing section.

6. Reports: Provide report to Owner including health assessment of plant material and growing media, and indication of work performed, with each site visit.
7. Continuing Maintenance Period:
 - a. Base Bid: 5 years from date of substantial completion.
 - b. Add Alternate: 20 years from date of substantial completion.

PART 2 PRODUCTS

2.1 SYSTEM SUPPLIER

- A. Supplier of vegetated roof assembly having systems and/or products approved for use:
 1. Basis of Design: VR Mod Vegetated Roof Assembly System by Tremco Inc., www.tremcoroofing.com
 2. Alternate Manufacturer: Paragreen Pre-Grown Vegetated Roof assembly by Siplast, www.siplast.com
 3. Alternate Manufacturer: LiveRoof Standard assembly by LiveRoof, LLC, www.liveroof.com

2.2 PERFORMANCE REQUIREMENTS

- A. Vegetated Roof Assembly: Provide vegetated roof assembly that will support vegetation, reaching an average coverage of not less than 85 percent coverage of the growing media within 24 months of installation.
- B. Water Capacity: Provide vegetated roof assembly with water retention capacity of a minimum of 4.0 gal/cu. ft. (535 L/cu. m) for VR Mod Meadow systems. Calculations include the combined water retention capacity of growing media and modular tray. For growing media, the water retention capacity is calculated by using the difference between dry and saturated weight as per ASTM E 2399-05. For the modular tray, the water retention capacity is found when measured in accordance with ASTM E 2398-11.
- C. Drainage: Provide vegetated roof assembly with rainfall drainage capacity not less than 15 in./hr. (38 cm/hr). Rainfall drainage capacity based on saturated hydraulic conductivity of growing media in accordance with ASTM E 2399-05.

- D. Structural Design Load: Provide vegetated roof assembly with superimposed dead load not exceeding load indicated on Drawings. Calculations must be based on saturated weight of all components of vegetated roof assembly and maximum media density at saturation of growing media in accordance with ASTM E 2399-05.
- E. Growing Media: Provide growing media that meets the following characteristics for the VR Mod system specified:
 - 1. VR Mod Meadow:
 - a. Depth: Not less than 4 inches (100 mm) [As indicated on Drawings].
- F. Vegetation:
 - 1. Source Location: Locally to project site, within 500 mile (800 km) radius.
 - 2. Verification: Ensure compatibility to growing media by Manufacturer prior to acceptance.

2.3 VEGETATED ROOF ASSEMBLY COMPONENTS

- A. Protection Sheet: Polyester membrane protection sheet made from 100% post-consumer recycled fibers.
 - 1. Physical Properties:
 - a. Thickness: 60 mil (1.52 mm).
 - b. Weight, ASTM D 3776: Minimum, 4.5 – 5 oz./sq. yd. (160 g/sq. m).
 - 2. Mechanical Properties:
 - a. Elongation, ASTM D 4632 : 50%.
 - b. Grab Tensile Strength, ASTM D 4632 : 100 lbf (444 N).
 - c. Trapezoid Tear, ASTM D 4533 : 45 lbf (200 N).
 - d. Puncture Strength, ASTM D 4833 : 65 lbf (288 N).
 - e. Mullen Burst, ASTM D 3786 : 210 psi (1448 kPa).
 - f. UV Resistance, ASTM D 4355 : 70%.

3. Hydraulic Properties:
 - a. Water Retention, ASTM F 726-06: 0.05 gal/sq. ft. (2.02 L/sq. m).
- B. Horizontal Insulation: Extruded-polystyrene board insulation, ASTM C 578, of type and minimum compressive strength indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84, unfaced; fabricated with shiplap or channel edges and with side facing Protection sheet having grooved drainage channels.
 1. Type VI, 40 psi (276 kPa).
 2. Thickness: As indicated on Drawings.
 - a. Water Retention Capacity: 1.1 gal/sq. ft. (45 L/sq. m).
- C. VR Mod Meadow Pre-Vegetated Modular Tray: Modular unit, pre-vegetated with forbs and graminoid plantings, that includes a permanent water retention and drainage layer, above which is situated an integrated filter fabric barrier and a built-in positive locking mechanism to attach the modules together, consisting of 100% recycled content.
 1. Modular Tray:
 - a. Physical Properties:
 - b. Tray Dimensions: 15 in x 20 in x 5.75 in (381 mm x 508 mm x 146 mm).
 2. Hydraulic Properties:
 - a. Water Retention Capacity: 1.5 gal/sq. ft. (62 L/sq. m).
- D. Technical Seam Tape: Self-adhered, waterproof membrane with acrylic pressure sensitive adhesive.
 1. Physical Properties:
 - a. Thickness: 9.9 mil (0.25 mm).
 2. Mechanical Properties:
 - a. Nail Sealability, ASTM E 331/547 (per AAMA 711-07, Annex 1): Pass both before and after thermal cycling.

E. Drain Inspection Box: Manufacturer's standard drain inspection box formed from aluminum, with lockable lid and perforated at drainage course level.

1. Physical Properties:

- a. Thickness: 60 mil (1.52 mm).
- b. Dimensions: 15 in x 15 in (375 mm x 375 mm).
- c. Height: 6 in (152 mm).
- d. Perforations, diameter: 3/4 in (19 mm).

F. Water Retention and Drainage Panel

1. Physical Properties:

- a. Thickness: 1 1/4" (32mm)
- b. Dimensions: 24 in x 24 in.

G. Filter Fabric: Highly permeable, non-woven, needle punched geo-textile separator.

1. Properties:

- a. Material: Polypropylene staple fiber
- b. Thickness 45 mil
- c. Permittivity: 2.2 sec⁻¹
- d. Water flow rate: 160 gpm/ft²

H. Edging Restraint: Manufacturer's standard L-shaped edging with top lip, formed from extruded aluminum. Solid at growing layer to prevent rooting and plant growth through the edging. Perforated at drainage course level to allow for free drainage. Use with Manufacturer's edging restraint connector.

1. Physical Properties:

- a. Thickness: 80 mil (2.03 mm).
- b. Height: 5.97 in (151.64 mm).

- c. Flange Length: 4 in (101.60 mm).
- d. Length: 8 ft (2.5 m).
- e. Lip: 3/8 in (9.525 mm).
- f. Perforations, diameter: 3/4 in (19 mm).

2.4 VEGETATED ROOF GROWING MEDIA

- A. Growing Media: Vegetated roof assembly manufacturer's engineered growing media, provided with pre-vegetated modular unit.

2.5 VEGETATED ROOF PLANTING MATERIALS

- A. Planting Materials, General: Provide plant materials of types indicated.
- B. Pre-vegetated Modular Tray Planting Materials:
 - 1. Planting Area 01 - VR Mod Meadow Wildflower Blend: Forbs and graminoid species that are healthy, vigorous, well-rooted specimens.

2.6 VEGETATION-FREE ZONE MATERIALS

- A. Aggregate Ballast: ASTM D 1863, No. 6 or No. 67, clean, dry, opaque, water-worn gravel, free of sharp edges.
 - 1. Size: ASTM D 448, Size 4, 3/4 to 1-1/2 inches (19 to 38 mm).

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and report any adverse conditions which may negatively impact appearance or performance of vegetated roof system. Ensure all unacceptable conditions are corrected before proceeding.
 - 1. Verify that roof insulation over membrane roofing is in place, secure, and flush along all seams.
 - 2. Verify that perimeter and other flashings are in place and secure along entire lengths where they will be covered by vegetated roof assembly.

- B. Ensure adequate provisions have been made for loading, unloading, storage, parking and access to roof site.
- C. Execute work in accordance with the specification, drawings and details.
- D. Report any imbedded object or obvious damage to Consultant.
- E. Ensure all equipment is in good working order. Protect all equipment which comes into contact with roofing membrane, flashings and related work.
- F. Ensure adequate safety equipment has been obtained for all operations.
- G. Proceed with installation of vegetated roof assembly only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Protect structures, utilities, sidewalks, pavements, and other facilities and areas from damage caused by installation.
- B. Protect roofing according to Manufacturer written recommendations to prevent damage and wear during examination, testing, installation, and remainder of construction period.

3.3 VEGETATED ROOF ASSEMBLY INSTALLATION

- A. Installation, General: Install vegetated roof assembly components according to Manufacturer's written instructions and approved shop drawings.
- B. Protection Sheet:
 - 1. Install protection sheet where indicated, in continuous installation over root barrier.
 - 2. Overlap all side and end laps a minimum of 4 inches (100 mm) and seal with Manufacturer's technical tape.
 - 3. Extend fabric 1-inch (25 mm) above ballast at perimeter and penetrations. Do not cover drains or restrict water flow to drains.
- C. Horizontal Insulation:

1. Loosely lay insulation in parallel courses, staggering end laps and side laps. Abut edges and ends between units.
2. Cut insulation to fit neatly at projections and terminations with less than 1-inch (25 mm) tolerance.

D. Drain Inspection Box:

1. Install inspection box centered over drains directly on the insulation board/protection sheet. Ensure the bottom inner edge of the inspection box is outside of the outer edge of the drain flange.
2. Install filter fabric over vertical drains and over lip of inspection box.
3. Cut slits in fabric to fit around locking pins and adhere to top inside edge with Manufacturer's technical tape.

E. Pre-Vegetated Modular Trays:

1. Install modular trays on roof surface, working top to bottom and left to right while locking modules together.
2. Insert lateral lines of irrigation system into quick-fit couplers on outside edge of pre-plumbed modular trays as per irrigation drawings.
3. Ensure side walls of modules on outside perimeter of vegetated areas are clean and dry.
4. Seal side walls on outside perimeter of vegetated areas with Manufacturer's 4-inch technical tape.
5. At cut modules, use a concrete saw with a new diamond blade. Mark the modular and cut from top to bottom until excess is fully separated.
6. Seal cut side of module with Manufacturer's 4-inch technical tape.
7. Turn the cut site of the module in to meet sidewall of adjacent full-size modules. Ensure a very tight fit.

F. Edging Restraint:

1. Install edging along perimeter border between vegetation-free area and vegetated area, according to Manufacturer's instructions and approved shop drawings.

2. When joining two sections together, ensure a tight fit at all joints. Remove backing from edge connector and apply to overlap both ends of joints. Press firmly.
3. At corners, cut and bend as required for clean, mitered finish.
4. Ensure base flange is pointed towards the vegetated areas and sits beneath pre-vegetated modules.

G. Planter Box Planting Buffer:

1. At each of the Six planters leave a 12” buffer of 6” depth growing media around the tray system so that students have an area to plant vegetation. Filter fabric should run under the media and be taped to the trays and to the edge metal to seal media from falling back under the trays.

3.4 VEGETATION-FREE ZONE INSTALLATION

- A. To roofed area, apply aggregate ballast uniformly over geotextile fabric at rate required by manufacturer, but not less than the following, carefully spreading aggregate to not damage roofing membrane and base flashings. Apply ballast as insulation is installed, leaving roofing membrane insulated and ballasted at end of workday.
 1. Ballast: 20 lb/sq. ft. (100 kg/sq. m), aggregate within 12 inches of roof perimeter and corners and 24 inches of roof penetrations; 10 lb/sq. ft. (50 kg/sq. m) aggregate elsewhere.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage membrane roofing and vegetated roof assembly Manufacturer's authorized technical service representative to provide full-time inspection of vegetated roof assembly installation and prepare interim and final inspection reports.
- B. Correct identified deficiencies or irregularities in work that do not comply with requirements.

3.6 PLANT MAINTENANCE

- A. General: During maintenance period prior to substantial completion, and during warranty period, maintain plantings by pruning, cultivating, supplemental watering if required, weeding, fertilizing if required, removal of debris from drainage areas, adjusting and repairing devices, resetting plants to proper elevations or vertical position, and performing other operations as required to establish healthy, viable plantings.
- B. Replace growing media that becomes displaced or eroded because of settling or other processes.
- C. Maintain integrated pest management program to keep plant materials, planted areas, and growing media free of pests and pathogens or disease following recommendations of USEPA as appropriate to minimize the use of pesticides and reduce hazards.
- D. Use only products and methods acceptable to membrane roofing Manufacturer.

3.7 CLEANING AND PROTECTION

- A. During planting and maintenance, keep adjacent areas and construction clean and maintain work area in an orderly condition.
- B. Protect vegetated roof assemblies from damage due to planting operations and operations of other contractors and trades. Repair or replace damaged vegetated roof assemblies.

END OF SECTION 07 33 63

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SECTION 07 42 13.23 - METAL COMPOSITE MATERIAL WALL PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Exterior curtain wall system consisting of formed metal composite material (MCM) sheet, framing, secondary supports, and anchors to structure.
- B. Matching flashing and trim.

1.2 SUBMITTALS

- A. Product Data - MCM Sheets: Manufacturer's data sheets on each product to be used, including thickness, physical characteristics, and finish, and:
 - 1. Finish manufacturer's data sheet showing physical and performance characteristics.
 - 2. Storage and handling requirements and recommendations.
 - 3. Fabrication instructions and recommendations.
- B. Product Data - Wall System: Manufacturer's data sheets on each product to be used, including:
 - 1. Physical characteristics of components shown on shop drawings.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation instructions and recommendations.
 - 4. Specimen warranty for wall system, as specified herein.
- C. Shop Drawings: Show layout and elevations, dimensions and thickness of panels, connections, details and location of joints, sealants and gaskets, method of anchorage, support clips, exposed fasteners, number of anchors, supports, reinforcement, trim, flashings, and accessories.
 - 1. Indicate panel numbering system.
 - 2. Differentiate between shop and field fabrication.

3. Indicate substrates and adjacent work with which the wall system must be coordinated.
 4. Include large-scale details of anchorages and connecting elements.
 5. Include large-scale details or schematic, exploded or isometric diagrams to fully explain flashing at a scale of not less than 1-1/2 inches per 12 inches.
 6. Include design engineer's stamp or seal on shop drawings for attachments and anchors.
- D. Design Data: Submit structural calculations stamped by design engineer, for Architect's information and project record.
- E. Test Report: Submit report of full-size mock-up tests for air infiltration, water penetration, and wind performance.
- F. Test Report: Submit test report verifying compliance with NFPA 285 for previously-tested exterior wall assembly.
- G. Testing agency's qualification statement.
- H. Maintenance Data: Care of finishes and warranty requirements.

1.3 QUALITY ASSURANCE

- A. Design Engineer's Qualifications: Design structural supports and anchorages under direct supervision of a Structural Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
- B. Testing Agency Qualifications: Independent agency experienced in testing assemblies of the type required for this project and having the necessary facilities for full-size mock-up testing of the type specified.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.
1. Protect finishes by applying heavy-duty removable plastic film during production.
 2. Package for protection against transportation damage.

3. Provide markings to identify components consistently with drawings.
 4. Exercise care in unloading, storing, and installing panels to prevent bending, warping, twisting, and surface damage.
- B. Store products protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
1. Store in well-ventilated space out of direct sunlight.
 2. Protect from moisture and condensation with tarpaulins or other suitable weathertight covering installed to provide ventilation.
 3. Store at a slope to ensure positive drainage of accumulated water.
 4. Do not store in enclosed space where ambient temperature can exceed 120 degrees F.
 5. Avoid contact with other materials that might cause staining, denting, or other surface damage.

1.5 FIELD CONDITIONS

- A. Do not install panels when air temperature or relative humidity are outside manufacturer's limits.

1.6 WARRANTY

- A. Finish Warranty: Provide 5-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in Owner's name and register with warrantor.
- B. Installation Warranty for Building Rainscreen Assembly: Installer of exterior rainscreen assembly (including air/vapor barrier and attachments, framing, and exterior panels) to provide 10-year warranty that includes coverage for defective materials and/or workmanship. This warranty will also clearly include materials, labor, necessary activity to access these areas, and removal of any materials to effect repairs and restore to watertight conditions.

PART 2 PRODUCTS

2.1 WALL PANEL SYSTEM

- A. Wall Panel System: Metal panels, fasteners, and anchors designed to be supported by framing or other substrate provided by others; provide installed panel system capable of maintaining specified performance without defects, damage, or failure.
 - 1. Provide structural design by or under direct supervision of a Structural Engineer licensed in the State in which the Project is located.
 - 2. Provide panel jointing and weatherseal using dry reveal system.
 - 3. Anchor panels to supporting framing without exposed fasteners.
- B. PERFORMANCE REQUIREMENTS
 - 1. Thermal Movement: Provide for free and noiseless vertical and horizontal thermal movement due to expansion and contraction under material temperature range of minus 20 degrees F to 180 degrees F without buckling, opening of joints, undue stress on fasteners, or other detrimental effects; allow for ambient temperature at time of fabrication, assembly, and erection procedures.
 - 2. Wind Performance: Provide system tested in accordance with ASTM E330/E330M without permanent deformation or failures of structural members under the following conditions:
 - a. Design Wind Pressure: In accordance with local building code.
 - b. Maximum deflection of perimeter framing member of $L/175$ normal to plane of the wall; maximum deflection of individual panels of $L/60$.
 - c. Maximum anchor deflection in any direction of $1/16$ inch at connection points of framing members to anchors.
 - 3. Water Penetration: No water penetration under static pressure when tested in accordance with ASTM E331 at a differential of 10 percent of inward acting design load, 6.24 psf minimum, after 15 minutes.
 - a. Water penetration is defined as the appearance of uncontrolled water on the interior face of the wall.

- b. Design to drain leakage and condensation to the exterior face of the wall.
- 4. Fire Performance: Use test method complying with NFPA 285.

2.2 MATERIALS

- A. Metal Composite Material (MCM) Sheet: Two sheets of aluminum sandwiching a core of extruded thermoplastic material; no foamed insulation material content.
 - 1. Overall Sheet Thickness: 0.157 inch, minimum.
 - 2. Face Sheet Thickness: 0.019 inch, minimum.
 - 3. Alloy: Manufacturer's standard, selected for best appearance and finish durability.
 - 4. Bond and Peel Strength: No adhesive failure of the bond between the core and the skin nor cohesive failure of the core itself below 22.4 inch-pound/inch with no degradation in bond performance, when tested in accordance with ASTM D1781, simulating resistance to panel delamination, after 8 hours of submersion in boiling water and after 21 days of immersion in water at 70 degrees F.
 - 5. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
 - 6. Flammability: Self-ignition temperature of 650 degrees F or greater when tested in accordance with ASTM D1929.
- B. Metal Framing Members: Include sub-girts, zee-clips, base and sill angles and channels, hat-shaped and rigid channels, and furring channels required for complete installation.
 - 1. Provide material strength, dimensions, configuration as required to meet applied loads and in compliance with applicable building code.

2.3 FINISHES

- A. Finish: Factory finished highly polished Class I natural anodized finish; AAMA 611 AA-M12C22A41, anodic coating not less than 0.7 mil, 0.0007 inch thick.
- B. Color/Texture: As selected by Architect from manufacturer's full range.

2.4 ACCESSORIES

- A. Flashing: Sheet aluminum; 0.040 inch thick, minimum; finish and color to match MCM sheet; see Section 07 62 00 for additional requirements.
- B. Anchors, Clips, and Accessories: Use one of the following:
 - 1. Stainless steel complying with ASTM A276/A276M, ASTM A480/A480M, or ASTM A666.
 - 2. Steel complying with ASTM A36/A36M and hot-dip zinc coating to ASTM A153/A153M.
 - 3. Steel complying with ASTM A36/A36M and hot-dip galvanized to ASTM A123/A123M, with Coating Thickness Grade of 100.
- C. Fasteners:
 - 1. Exposed Fasteners: Stainless steel; permitted only where absolutely unavoidable and subject to prior approval of the Architect.
 - 2. Screws: Self-drilling or self-tapping Type 410 stainless steel or zinc-alloy steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal wall panels.
 - 3. Bolts: Stainless steel.
 - 4. Fasteners for Flashing and Trim: Blind fasteners of high-strength aluminum or stainless steel.
- D. Provide panel system manufacturer's and installer's standard corrosion resistant accessories, including fasteners, clips, anchorage devices, and attachments.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine dimensions, tolerances, and interfaces with other work.
- B. Examine substrate on-site to determine that conditions are acceptable for product installation in accordance with manufacturer's written instructions.

- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- D. Notify Architect in writing of conditions detrimental to proper and timely completion of work, and do not proceed with erection until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Do not install products that are defective, including warped, bowed, dented, and broken members, and members with damaged finishes.
- B. Comply with instructions and recommendations of MCM sheet manufacturer and wall system manufacturer, as well as with approved shop drawings.
- C. Install wall system securely allowing for necessary thermal and structural movement; comply with wall system manufacturer's instructions for installation of concealed fasteners.
- D. Do not handle or tool products during erection in manner that damages finish, decreases strength, or results in visual imperfection or failure in performance. Return component parts that require alteration to shop for refabrication, if possible, or for replacement with new parts.
- E. Do not form panels in field unless required by wall system manufacturer and approved by the Architect; comply with MCM sheet manufacturer's instructions and recommendations for field forming.
- F. Separate dissimilar metals; use gasket fasteners, isolation shims, or isolation tape where needed to eliminate possibility of electrolytic action between metals.
- G. Install flashings as indicated on shop drawings. At flashing butt joints, provide a lap strap under flashing and seal lapped surfaces with a full bed of non-hardening sealant.
- H. Install square, plumb, straight, and true, accurately fitted, with tight joints and intersections maintaining the following installation tolerances:
 - 1. Variation From Plane or Location: 1/2 inch in 30 feet of length and up to 3/4 inch in 300 feet, maximum.
 - 2. Deviation of Vertical Member From True Line: 0.1 inch in 25 feet run, maximum.

3. Deviation of Horizontal Member From True Line: 0.1 inch in 25 feet run, maximum.
4. Offset From True Alignment Between Two Adjacent Members Abutting End To End, In Line: 0.03 inch, maximum.

I. Replace damaged products.

3.3 CLEANING

- A. Ensure weep holes and drainage channels are unobstructed and free of dirt and sealants.
- B. Remove protective film after installation of joint sealers, after cleaning of adjacent materials, and immediately prior to completion of work.
- C. Remove temporary coverings and protection of adjacent work areas.
- D. Clean installed products in accordance with manufacturer's instructions.

3.4 PROTECTION

- A. Protect installed panel system from damage until Date of Substantial Completion.

END OF SECTION 07 42 13.23

SECTION 07 54 00 - THERMOPLASTIC MEMBRANE ROOFING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Adhered system with thermoplastic roofing membrane.
- B. Cover boards.
- C. Flashings.
- D. Roofing cant strips, stack boots, and walkway pads.

1.2 REFERENCE STANDARDS

- A. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
- B. {RSTEMP#3013}
- C. ASTM E1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.
- D. FM DS 1-28 - Wind Design.
- E. NRCA (RM) - The NRCA Roofing Manual.
- F. NRCA (WM) - The NRCA Waterproofing Manual.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section.
 - 1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.4 SUBMITTALS

- A. Product Data: Provide data indicating membrane materials, flashing materials, insulation, vapor retarder, surfacing, and fasteners.
- B. Shop Drawings: Submit drawings that indicate joint or termination detail conditions, conditions of interface with other materials, and paver layout.

- C. Manufacturer's Field Reports: Indicate procedures followed, ambient temperatures, humidity, wind velocity during application, and supplementary instructions given.
- D. Manufacturer's qualification statement.
- E. Installer's qualification statement.
- F. Warranty Documentation:
 - 1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
 - 2. Submit installer's written verification that installation complies with warranty conditions for waterproof membrane.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of this section with at least three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact, unless otherwise indicated.
- B. Store materials in weather protected environment, clear of ground and moisture.
- C. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.
- D. Protect foam insulation from direct exposure to sunlight.

1.7 FIELD CONDITIONS

- A. Do not apply roofing membrane during unsuitable weather.
- B. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

- C. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.
- D. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

1.8 WARRANTY

- A. System Warranty: Provide manufacturer's system warranty agreeing to repair or replace roofing that leaks or is damaged due to wind or other natural causes.
 - 1. Warranty Term: 20 years-no dollar limit.
 - 2. Wind Speed Warranty up to 90 miles per hour.
 - 3. For repair and replacement include costs of both material and labor in warranty.
- B. Vegetated Roof Systems Over Roofing: Provide manufacturer's twenty year, single-source "full system" warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Thermoplastic Ketone Ethylene Ester (KEE) Fleeceback Membrane Roofing Materials:
 - 1. Basis of Design - Tremco Roofing Inc; TremPly KEE FB: www.tremcoroofing.com
 - 2. Mule-Hide Products Co, Inc; PVC KEE HP: www.mulehide.com/#sle.
 - 3. Carlisle SynTec Systems; Sure-Flex PVC KEE: www.carlisle-syntec.com/#sle.

2.2 ROOFING

- A. Thermoplastic Membrane Roofing: One ply membrane, fully adhered, over insulation.
- B. Roofing Assembly Requirements:
 - 1. Solar Reflectance Index (SRI): Minimum of 64 based on three-year aged value; if three-year aged data is not available, minimum of 82 initial value.
 - a. Calculate SRI in accordance with ASTM E1980.

- b. Field applied coating may not be used to achieve specified SRI.
- 2. Factory Mutual Classification: Class 1 and windstorm resistance of 1-90, in accordance with FM DS 1-28.

2.3 MEMBRANE ROOFING AND ASSOCIATED MATERIALS

A. Membrane Roofing Materials:

- 1. KEE: Ketone ethylene ester (KEE) complying with {RS#3013}, sheet reinforced with fabric.
 - a. Thickness: 60 mil, 0.060 inch, minimum.
- 2. Sheet Width: Factory fabricated into widest possible sheets.
- 3. Solar Reflectance: 0.70, minimum, initial, and 0.65, minimum, 3-year, certified by Cool Roof Rating Council.
- 4. Color: White.

B. Seaming Materials: As recommended by membrane manufacturer.

C. Flexible Flashing Material: Material recommended by membrane manufacturer.

2.4 COVER BOARDS

A. Cover Boards: Glass-mat faced gypsum panels complying with ASTM C1177/C1177M.

- 1. Thickness: 5/8 inch, Type X, fire-resistant.
- 2. Board Size: 48 by 48 inch.

2.5 ACCESSORIES

- A. Sheathing Adhesive: Noncombustible type, for adhering gypsum sheathing to metal deck.
- B. Sheathing Joint Tape: Paper type, 3 inches wide, self adhering.
- C. Insulation Joint Tape: Glass fiber reinforced type as recommended by insulation manufacturer, compatible with roofing materials; 6 inches wide; self adhering.

- D. Membrane Adhesive: As recommended by membrane manufacturer.
- E. Sealants: As recommended by membrane manufacturer.
- F. Walkway Pads: Suitable for maintenance traffic, contrasting color or otherwise visually distinctive from roof membrane.
 - 1. Composition: Roofing membrane manufacturer's standard.
 - 2. Surface Color: White or Yellow.
- G. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, aluminum transition tape as required at transitions to non-compatible membrane materials, and other accessories.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces and site conditions are ready to receive work.
- B. Verify deck is supported and secure.
- C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.
- D. Verify deck surfaces are dry and free of snow or ice.
- E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.2 INSTALLATION, GENERAL

- A. Perform work in accordance with manufacturer's instructions, NRCA (RM), and NRCA (WM) applicable requirements.
- B. Do not apply roofing membrane during cold or wet weather conditions.
- C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.

- D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
- E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

3.3 INSULATION - UNDER MEMBRANE

- A. Tape joints of insulation in accordance with roofing and insulation manufacturers' instructions.

3.4 INSTALLATION - MEMBRANE

- A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.
- B. Shingle joints on sloped substrate in direction of drainage.
- C. Fully Adhered Application: Apply adhesive to substrate at rate required to achieve uplift requirements. Fully embed membrane in adhesive except in areas directly over or within 3 inches of expansion joints. Fully adhere one roll before proceeding to adjacent rolls.
- D. Overlap edges and ends and seal seams by contact adhesive, minimum 3 inches. Seal permanently waterproof. Apply uniform bead of sealant to joint edge.
- E. At intersections with vertical surfaces:
 - 1. Extend membrane over cant strips and up a minimum of 4 inches onto vertical surfaces.
 - 2. Fully adhere flexible flashing over membrane and up to nailing strips.
- F. Around roof penetrations, seal flanges and flashings with flexible flashing.
- G. Coordinate installation of roof drains and sumps and related flashings.

3.5 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Provide daily on-site attendance of roofing and insulation manufacturer's representative during installation of this work.

- C. Testing Agency: Engage a qualified testing agency to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components, and to furnish reports to Architect.
- D. Flood Testing: Flood test each roofing area for leaks, according to recommendations in ASTM D 5957, after completing roofing and flashing but before overlying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.
 - 1. Flood to an average depth of 2-1/2 inches (65 mm) with a minimum depth of 1 inch (25 mm) and not exceeding a depth of 4 inches (100 mm). Maintain 2 inches (50 mm) of clearance from top of base flashing.
 - 2. Flood each area for 24 hours.
 - 3. After flood testing, repair leaks, repeat flood tests, and make further repairs until roofing and flashing installations are watertight.
- E. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
- F. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.
- G. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.6 CLEANING

- A. See Section 01 70 00 - Execution and Closeout Requirements for additional requirements.
- B. Remove bituminous markings from finished surfaces.
- C. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.
- D. Repair or replace defaced or damaged finishes caused by work of this section.

3.7 PROTECTION

- A. Protect installed roofing and flashings from construction operations.
- B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION 07 54 00

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fabricated sheet metal items, including brake metal, copings, flashings, counterflashings, scuppers, gravel stops, gutters, downspouts, and metal trim .
- B. Flashing for roof drains and roof penetrations.

1.2 REFERENCE STANDARDS

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- B. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free.
- C. SMACNA (ASMM) - Architectural Sheet Metal Manual.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section.

1.4 SUBMITTALS

- A. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
- B. Samples for Verification: Submit two samples 3 by 3 inch minimum in size illustrating metal finish color for each material and color.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA (ASMM) requirements and standard details, except as otherwise indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.1 SHEET MATERIALS

- A. Stainless Steel: ASTM A666, Type 304 alloy, soft temper.

2.2 METAL FLASHING APPLICATIONS

- A. Brake Metal (076200-A)

- 1. Material: Pre-Finished Aluminum
 - 2. Thickness: 0.050 inch
 - 3. Color: As selected by Architect

- B. Metal Coping (Lap Method) (076200-C)

- 1. Material: Pre-Finished Aluminum
 - 2. Thickness: 0.050 inch
 - 3. Color: As selected by Architect
 - 4. Fabricate in minimum 96-inch long, but not exceeding 10-foot long, sections.
 - 5. Furnish with continuous cleats on both sides of coping.
 - 6. Provide shop fabricated end and corner sections minimum 18 inches long.

- C. Flashing (076200-D)

- 1. Material: Pre-Finished Aluminum
 - 2. Thickness: 0.050 inch
 - 3. Color: As selected by Architect

- D. Scuppers (076200-G)

- 1. Material: Pre-Finished Aluminum
 - 2. Thickness: 24 gage
 - 3. Color: As selected by Architect

4. Fabrication: SMACNA Detail ____ and ____.

E. Gutter (076200- K)

1. Material: Pre-Finished Aluminum
2. Thickness: 0.040 inch
3. Color: As selected by Architect
4. Fabrication: SMACNA (ASMM) Rectangular profile
5. Size: As Indicated.

F. Downspouts (076200-J)

1. Material: Pre-Finished Aluminum
2. Thickness: 0.040 inch
3. Color: As selected by Architect
4. Fabrication: Round profile
5. Size for rainfall intensity determined by a storm occurrence of 1 in 10 years in accordance with SMACNA (ASMM).
6. Size: As Indicated.
7. Anchorage Devices: Profiled to suit gutters and downspouts in accordance with SMACNA or as recommended by manufacturer.
8. Supports: Brackets.
9. Downspout Extenders: Same material and finish as downspouts.

G. Two-Piece Metal Counterflashing (076200-E)

1. Material: Pre-Finished Aluminum
2. Thickness: 26 gage
3. Color: As selected by Architect

2.3 FABRICATION - GENERAL

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Form pieces in longest possible lengths.
- C. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- E. Tin edges of copper sheet to be soldered; solder shop formed metal joints, and after soldering, remove flux, wipe and wash solder joints clean; provide weathertight joints.
- F. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.
- G. Fabricate flashings to allow toe to extend 2 inches over roofing gravel. Return and brake edges.

2.4 ACCESSORIES

- A. Fasteners: Same material and finish as flashing metal, with soft neoprene washers.
- B. Primer: Zinc chromate type.
- C. Concealed Sealants: Non-curing butyl sealant.
- D. Plastic Cement: ASTM D4586/D4586M, Type I.
- E. Splash Pads: Precast concrete type, of size and profiles indicated; minimum 3000 psi at 28 days, with minimum 5 percent air entrainment.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
- B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.2 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.
- B. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.

3.3 INSTALLATION

- A. Comply with drawing details.
- B. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted.
- C. Apply plastic cement compound between metal flashings and felt flashings.
- D. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- E. Seal or solder metal joints watertight for full metal surface contact. After soldering, wash metal clean with neutralizing solution and rinse with clean water.
- F. Secure gutters and downspouts in place with concealed fasteners.
- G. Slope gutters 1/4 inch per 10 feet, minimum.

END OF SECTION 07 62 00

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SECTION 07 84 00 - FIRESTOPPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Firestopping systems.
- B. Firestopping of joints and penetrations in fire-resistance-rated and smoke-resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.2 REFERENCE STANDARDS

- A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
- B. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
- C. ASTM E1966 - Standard Test Method for Fire Resistive Joint Systems.
- D. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestops.
- E. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.
- F. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies.
- G. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- H. ITS (DIR) - Directory of Listed Products.
- I. FM (AG) - FM Approval Guide.
- J. UL 1479 - Standard for Fire Tests of Penetration Firestops.
- K. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems.
- L. UL (DIR) - Online Certifications Directory.
- M. UL (FRD) - Fire Resistance Directory.

1.3 SUBMITTALS

- A. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
- B. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer's qualification statement.
- E. Installer's qualification statement.

1.4 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
 - 1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section.

1.5 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.
- B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Firestopping Manufacturers:
 - 1. 3M Fire Protection Products: www.3m.com/firestop/#sle.

2. A/D Fire Protection Systems Inc: www.adfire.com/#sle.
3. Hilti, Inc: www.us.hilti.com/#sle.
4. Nelson FireStop Products: www.nelsonfirestop.com/#sle.
5. Specified Technologies Inc: www.stifirestop.com/#sle.

2.2 MATERIALS

- A. Firestopping Materials: Any materials meeting requirements.
- B. Mold and Mildew Resistance: Provide firestopping materials with mold and mildew resistance rating of zero(0) in accordance with ASTM G21.
- C. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.
- D. Fire Ratings: Refer to drawings for required systems and ratings.

2.3 FIRESTOPPING ASSEMBLY REQUIREMENTS

- A. Head-of-Wall (HW) Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of wall assembly.
- B. Floor-to-Floor (FF), Floor-to-Wall (FW), Head-of-Wall (HW), and Wall-to-Wall (WW) Joints, Except Perimeter, Where Both Are Fire-Rated: Use system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
 1. Air Leakage: Provide systems that have been tested to show L Rating as indicated.
- C. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.
 1. Air Leakage: Provide systems that have been tested to show L Rating as indicated.
 2. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.

2.4 FIRESTOPPING SYSTEMS

- A. Firestopping: Any material meeting requirements.
 - 1. Fire Ratings: Use system that is listed by FM (AG), ITS (DIR), or UL (FRD) and tested in accordance with ASTM E814, ASTM E119, or UL 1479 with F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.
 - 2. Fire Ratings: See drawings for required systems and ratings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify openings are ready to receive the work of this section.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.

3.3 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Install labeling required by code.

3.4 FIELD QUALITY CONTROL

- A. Independent Testing Agency: Inspection agency employed and paid by Owner, will examine penetration firestopping in accordance with ASTM E2174 and ASTM E2393.
- B. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

3.5 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.6 PROTECTION

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION 07 84 00

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SECTION 07 92 00 - JOINT SEALANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nonsag gunnable joint sealants.
- B. Self-leveling pourable joint sealants.
- C. Joint backings and accessories.

1.2 REFERENCE STANDARDS

- A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer.
- B. ASTM C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants.
- C. ASTM C834 - Standard Specification for Latex Sealants.
- D. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications.
- E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
- F. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems.
- G. ASTM C1193 - Standard Guide for Use of Joint Sealants.
- H. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants.
- I. ASTM C1311 - Standard Specification for Solvent Release Sealants.
- J. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants.
- K. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints.
- L. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness.

M. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168.

1.3 SUBMITTALS

- A. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
 - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
 - 2. List of backing materials approved for use with the specific product.
 - 3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
 - 4. Substrates the product should not be used on.
 - 5. Substrates for which use of primer is required.
 - 6. Substrates for which laboratory adhesion and/or compatibility testing is required.
- B. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, VOC content, and recommended tools.
- C. Color Cards for Preliminary Selection: Where sealant color is not specified, submit manufacturer's color cards showing full range of colors available for selection. Architect may select up to three colors for final selection at each condition.
- D. Field Samples for Verification: Provide a maximum of three color samples for each condition requiring color selection (up to 6 locations selected by Architect), including custom colors, installed in-situ, 12 inches in length, to be reviewed by Architect for final color selection.
- E. Preconstruction Laboratory Test Reports: Submit with Product Data.
- F. Joint Sealant Schedule: Include the following information:
 - 1. Joint sealant substrate application, joint location, and designation.
 - 2. Joint sealant manufacturer and product name.
 - 3. Joint sealant primer and backer.

- 4. Joint sealant color.
- 5. Any special conditions.
- G. Field Quality Control Plan: Submit at least two weeks prior to start of installation.
- H. Field Quality Control Log: Submit filled out log for each length or instance of sealant installed, within 10 days after completion of inspections/tests; include bagged test samples and photographic records, if any.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience and approved by manufacturer.
- C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.
- D. Preconstruction Laboratory Testing:
 - 1. Adhesion Testing: In accordance with ASTM C794.
 - 2. Compatibility Testing: In accordance with ASTM C1087.
 - 3. Stain Testing: In accordance with ASTM C1248; required only for porous substrates.
 - 4. Provide data showing previous testing on each combination of sealant, substrate, backing and accessories used on this Project, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.
 - a. If a substrate used on the Project has not been tested within the last 24 months, arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories. Allow sufficient time for testing to avoid delaying the work, and deliver sufficient samples to manufacturer for testing. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
- E. Field Quality Control Plan:

1. Visual inspection of entire length of sealant joints.
2. Destructive field adhesion testing of sealant joints, except interior sealant joints.
 - a. For each different sealant and substrate combination, allow for one test every 1000 linear feet (305 meters).
 - b. If any failures occur in the first 1000 linear feet, continue testing at frequency of one test per 500 linear feet at no extra cost to Owner.
3. Field testing agency's qualifications.
4. Field Quality Control Log Form: Show same data fields as on Joint Sealant Schedule, adding date of installation of field sample to be tested and date of test, with known information filled out and lines for multiple tests per sealant/substrate combinations; include visual inspection and specified field testing; allow for possibility that more tests than minimum specified may be necessary.

F. Field Adhesion Test Procedures:

1. Allow sealants to fully cure as recommended by manufacturer before testing.
2. Have a copy of the test method document available during tests.
3. Take photographs or make video records of each test, with joint identification provided in the photos/videos; for example, provide small erasable whiteboard positioned next to joint.
4. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
5. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer, and report any deficiencies.
6. Deliver the samples removed during destructive tests in separate sealed plastic bags, identified with project, location, test date, and test results, to Owner.
7. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.

- G. Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Destructive Tail Procedure.
1. Sample: At least 18 inches long.
 2. Minimum Elongation Without Adhesive Failure: Consider the tail at rest, not under any elongation stress; multiply the stated movement capability of the sealant in percent by two; then multiply 1 inch by that percentage; if adhesion failure occurs before the "1 inch mark" is that distance from the substrate, the test has failed.
 3. If either adhesive or cohesive failure occurs prior to minimum elongation, take necessary measures to correct conditions and re-test; record each modification to products or installation procedures.
 4. Record results on Field Quality Control Log.
 5. Repair failed portions of joints.

1.5 WARRANTY

- A. Correct defective work within a five year period after Date of Substantial Completion.
- B. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal, exhibit loss of adhesion or cohesion, or do not cure.
1. Provide 20-year warranty for silicones; minimum 10-year warranty for urethanes.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Non-Sag Sealants: Permits application in joints on vertical surfaces without sagging or slumping.
1. Dow Corning Corporation: www.dowcorning.com/construction/#sle.
 2. Pecora Corporation: www.pecora.com.
 3. Sherwin-Williams Company: www.sherwin-williams.com.
 4. Sika Corporation: www.usa-sika.com.

5. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
- B. Self-Leveling Sealants: Pourable or self-leveling sealant that has sufficient flow to form a smooth, level surface when applied in a horizontal joint.
 1. Dow Corning Corporation: www.dowcorning.com/construction/#sle.
 2. Pecora Corporation: www.pecora.com.
 3. Sika Corporation: www.usa-sika.com.
 4. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
 5. W.R. Meadows, Inc: www.wrmeadows.com/sle.

2.2 JOINT SEALANT APPLICATIONS

A. Scope:

1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
 - a. Wall expansion and control joints.
 - b. Joints between door, window, and other frames and adjacent construction.
 - c. Joints between different exposed materials.
 - d. Openings below ledge angles in masonry.
 - e. Other joints indicated below.
2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
 - a. Joints between door, window, and other frames and adjacent construction.
 - b. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.

- 1) Exception: Through-penetrations in sound-rated assemblies that are also fire-rated assemblies.
- c. Other joints indicated below.
3. Do not seal the following types of joints.
 - a. Intentional weepholes in masonry.
 - b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
 - c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
 - d. Joints where installation of sealant is specified in another section.
 - e. Joints between suspended panel ceilings/grid and walls.
- B. Exterior Joints: Use nonsag non-staining silicone sealant, unless otherwise indicated.
 1. Lap Joints in Sheet Metal Fabrications: Butyl rubber, non-curing.
 2. Control and Expansion Joints in Concrete Paving: Self-leveling or Nonsag polyurethane "traffic-grade" sealant.
 3. Concealed, non-dynamic "bedding" joints, such as door thresholds: Butyl rubber, non-curing
- C. Interior Joints: Use nonsag polyurethane sealant, unless otherwise indicated.
 1. Wall and Ceiling Joints in Non-Wet Areas: Acrylic emulsion latex sealant.
 2. Floor Joints in Wet Areas: Nonsag or Self-leveling polyurethane "traffic-grade" sealant suitable for continuous liquid immersion.
 3. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; clear.
 4. In Sound-Rated Assemblies: Acrylic emulsion latex or water-based elastomeric sealant.

5. Narrow Control Joints in Interior Exposed Concrete Slabs: Self-leveling epoxy sealant.
 6. Tile control and expansion joints in Wet Areas: Mildew-resistant silicone sealant
- D. Interior Wet Areas include: Bathrooms, restrooms, kitchens, food service areas, and food processing areas; fixtures in wet areas include plumbing fixtures, countertops, cabinets, and other similar items.
- E. Sound-Rated Assemblies: Walls and ceilings identified as STC-rated, sound-rated, or acoustical.

2.3 NONSAG JOINT SEALANTS

- A. Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus 50 percent, minimum.
 2. Non-Staining To Porous Materials: Non-staining to porous materials when tested in accordance with ASTM C1248.
 3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
 4. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661.
 5. Custom Color: To be selected by Architect from manufacturer's full custom range.
 6. Cure Type: Single-component, neutral moisture curing.
- B. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
1. Custom Color: To be selected by Architect.
- C. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multicomponent; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus 50 percent, minimum.
 2. Hardness Range: 25 to 35, Shore A, when tested in accordance with ASTM C661.

3. Custom Color: To be selected by Architect from manufacturer's full custom range.
- D. Nonsag "Traffic-Grade" Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multicomponent; explicitly approved by manufacturer for continuous water immersion and traffic without the necessity to recess sealant below traffic surface.
 1. Movement Capability: Plus and minus 25 percent, minimum.
 2. Hardness Range: 25 to 35, Shore A, when tested in accordance with ASTM C661.
 3. Color: To be selected by Architect from manufacturer's full range.
- E. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.
 1. Color: To be selected by Architect from manufacturer's full range.
- F. Non-Curing Butyl Sealant: Solvent-based; ASTM C1311; single component, nonsag, non-skinning, non-hardening, non-bleeding; vapor-impermeable; intended for fully concealed applications.

2.4 SELF-LEVELING SEALANTS

- A. Self-Leveling Polyurethane Sealant: ASTM C920, Grade P, Uses M and A; single or multicomponent; explicitly approved by manufacturer for traffic exposure; not expected to withstand continuous water immersion.
 1. Movement Capability: Plus and minus 25 percent, minimum.
 2. Hardness Range: 25 to 35, Shore A, when tested in accordance with ASTM C661.
 3. Color: To be selected by Architect from manufacturer's full range.
- B. Self-Leveling Polyurethane Sealant for Continuous Water Immersion: Polyurethane; ASTM C920, Grade P, Uses M and A; single or multicomponent; explicitly approved by manufacturer for traffic exposure and continuous water immersion.
 1. Movement Capability: Plus and minus 25 percent, minimum.
 2. Hardness Range: 25 to 35, Shore A, when tested in accordance with ASTM C661.
 3. Color: To be selected by Architect from manufacturer's full range.

- C. Semi-Rigid Self-Leveling Epoxy Joint Filler: Epoxy or epoxy/polyurethane copolymer; intended for filling cracks and control joints not subject to significant movement; rigid enough to support concrete edges under traffic.
 - 1. Composition: Single or multicomponent, 100 percent solids by weight.
 - 2. Durometer Hardness: Minimum of 85 for Type A or 35 for Type D, after seven days when tested in accordance with ASTM D2240.
 - 3. Custom Color: To be selected by Architect <>.
 - 4. Joint Width, Minimum: 1/8 inch.

2.5 ACCESSORIES

- A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
 - 1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type C - Closed Cell Polyethylene.
 - 2. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.
 - 3. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.
- B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
- C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.
- D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.
- E. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Verify that backer rods are of the correct size.

3.2 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in inconspicuous area to verify that it does not stain or discolor slab.

3.3 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Perform installation in accordance with ASTM C1193.

C. Perform acoustical sealant application work in accordance with ASTM C919.

D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.

E. Install bond breaker backing tape where backer rod cannot be used.

F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

- I. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.
- C. Destructive Adhesion Testing: If there are any failures in first 1000 linear feet, notify Architect immediately.
- D. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.
- E. Repair destructive test location damage immediately after evaluation and recording of results.

END OF SECTION 07 92 00

SECTION 08 06 71 – DOOR HARDWARE SCHEDULE

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 references specification sections relating to commercial door hardware for the following:
 - 1. Swinging doors.
 - 2. Sliding Doors.
 - 3. Other doors to the extent indicated.
- B. Commercial door hardware includes, but is not necessarily limited to, the following:
 - 1. Mechanical door hardware.
 - 2. Electromechanical and access control door hardware.
 - 3. Electromechanical and access control door hardware power supplies, back-ups and surge protection.
 - 4. Automatic operators.
 - 5. Cylinders specified for doors in other sections.
- C. Related Sections:
 - 1. Division 08 Section “Door 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 70 - National Electrical Code.
 - 4. NFPA 80 - Fire Doors and Windows.
 - 5. NFPA 101 - Life Safety Code.
 - 6. NFPA 105 - Installation of Smoke Door Assemblies.
 - 7. State Building Codes, Local Amendments.
- E. Standards: Reference Related Sections for requirements regarding compliance with applicable industry standards.

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. 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.
- D. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.
- 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 the Related Sections.

1.4 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".

1.5 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.

1.6 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. Refer to "PART 3 – EXECUTION" for required specification sections.

PART 3 - EXECUTION

3.1 DOOR HARDWARE SETS

- A. The door hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule.

Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.
 2. The supplier is responsible for handing and sizing all products.
 3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
 4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.
- B. Products listed in the hardware sets shall be supplied by and in accordance with the requirements described in the specification section as noted for each item.
1. Section 08 71 00 – Door Hardware.
- C. Manufacturer's Abbreviations:
1. MK - McKinney
 2. PE - Pemko
 3. SU - Securitron
 4. RO - Rockwood
 5. YA - ASSA ABLOY ACCENTRA
 6. HS - HES
 7. RF - Rixson
 8. NO - Norton
 9. SA - SARGENT
 10. OT - Other

Hardware Sets

Set: 1.0

Doors: 001

2 Continuous Hinge	CFM__HD1 PT X LAR		PE
2 Electric Power Transfer	EL-CEPT	630	SU ⚡
1 Concealed Vert Rod Exit, Classroom	7220 B MELR 503F (MELR, REX)	630	YA ⚡

1 Concealed Vert Rod Exit, Exit Only	7220 B MELR EO (MELR, REX)	630	YA	⚡
1 Cylinder (Mortise or Rim as required)	Cylinder to match existing system	626	YA	
2 Pull	RM3131-12 Mtg-Type 12	US32D	RO	
1 Automatic Opener (pair, UNI arm)	D6061-36 D	689	NO	⚡
1 Gasketing	By Door Manufacturer		00	
2 Sweep	307APK		PE	
1 Threshold	273x3AFG MSES10SS		PE	
2 ElectroLynx Harness (frame)	QC-C1500P		MK	⚡
2 ElectroLynx Harness (door)	QC-C*** (Length / Type as Required)		MK	⚡
1 Wiring Diagram	WD-SYSPK (Elevations and Point to Point)		SA	
2 Position Switch	DPS-M-BK		SU	⚡
1 Door Switch	502		NO	⚡
1 Switch Post	500	689	NO	⚡
1 Keyswitch	MKA		SU	⚡
1 Power Supply w/ Distribution Board	AQL4-R8E1		SU	⚡

Notes: OUTSIDE OPERATION: DURING NORMAL HOURS PUSHING OUTSIDE PUSH BUTTON UNLOCKS EXIT DEVICES AND ACTIVATES OPERATORS. AFTER HOURS OUTSIDE PUSH BUTTON IS TURNED OFF BY KEY SWITCH.

INSIDE OPERATION: PUSHING PUSH BUTTON WILL UNLOCK EXIT AND ACTIVATE OPERATOR. EGRESS IS BY EXIT DEVICE. EMERGENCY ACCESS IS BY KEY.

Set: 2.0

Doors: 101, 102

6 Hinge (heavy weight)	T4A3786	US26D	MK	
2 Fire Rated Surf Vert Rod, Exit Only	7170F LBR EO	630	YA	
2 Surface Closer	(PR) 7500 (Reg or PA) (brackets and drop plate as required)	689	NO	
2 Kick Plate	K1050 10" high BEV CSK	US32D	RO	
2 Electromagnetic Holder	998 X voltage as required	689	RF	⚡
1 Astragal	S771C		PE	
1 Gasketing	S88BL (Head & Jambs)		PE	

Notes: MAGNETIC HOLD OPEN RELEASED WHEN FIRE ALARM IS ACTIVATED.

Set: 3.0

Doors: 007A

6 Hinge (heavy weight)	T4A3786	US26D	MK
2 Surface Vert Rod Exit, Classroom	7175 LBR MO626F	630	YA
4 Cylinder (Mortise or Rim as required)	Cylinder to match existing system	626	YA
2 Surface Closer	(PR) 7500 (Reg or PA) (brackets and drop plate as required)	689	NO
2 Kick Plate	K1050 10" high BEV CSK	US32D	RO
2 Electromagnetic Holder	998 X voltage as required	689	RF ⚡
2 Silencer	608		RO

Notes: MAGNETIC HOLD OPEN RELEASED WHEN FIRE ALARM IS ACTIVATED.

Set: 3.1

Doors: 113

3 Hinge (heavy weight)	T4A3786	US26D	MK
1 Rim Exit Device, Passage	7100 MO628F	630	YA
1 Surface Closer	CLP7500 (brackets and drop plate as required)	689	NO
1 Gasketing	S88BL (Head & Jambs)		PE

Set: 4.0

Doors: 003, 007K

6 Hinge, Full Mortise	TA2714xNRP	US26D	MK
2 Flush Bolt (manual)	555 (metal) / 557 (wood)	US26D	RO
1 Dust Proof Strike	570	US26D	RO
1 Storeroom or Closet Lock	MOR 8805FL LC	626	YA
1 Cylinder (Mortise or Rim as required)	Cylinder to match existing system	626	YA
2 Surface Overhead Holder/Stop	10-X46	630	RF
2 Silencer	608		RO

Set: 5.0

Doors: 005

3 Hinge, Full Mortise	TA2714	US26D	MK
1 Storeroom or Closet Lock	MOR 8805FL LC	626	YA
1 Cylinder (Mortise or Rim as required)	Cylinder to match existing system	626	YA
1 Surface Closer	7500 (brackets and drop plate as required)	689	NO
1 Kick Plate	K1050 10" high BEV CSK	US32D	RO
1 Wall/ Floor Stop	RM861 / RM850	US32D	RO
3 Silencer	608		RO

Set: 6.0

Doors: 004

3 Hinge, Full Mortise	TA2714	US26D	MK
1 Storeroom or Closet Lock	MOR 8805FL LC	626	YA
1 Cylinder (Mortise or Rim as required)	Cylinder to match existing system	626	YA
1 SMART Pac Bridge Rectifier	2005M3		HS ⚡
1 Electric Strike	1600-CLB	630	HS ⚡
1 Surface Closer	7500 (brackets and drop plate as required)	689	NO
1 Wall/ Floor Stop	RM861 / RM850	US32D	RO
3 Silencer	608		RO
1 Power Supply w/ Distribution Board	AQL4-R8E1		SU ⚡

Notes: CARD READER BY SECURITY VENDOR. PRESENTING AUTHORIZED CREDENTIAL TO CARD READER WILL UNLOCK ELECTRIC STRIKE ALLOWING ACCESS. FREE EGRESS BY LEVER.

Set: 7.0

Doors: 122

2 Continuous Hinge	DFM120HD1 PT		PE
2 Electric Power Transfer (bronze)	EL-CEPT	613E	SU ⚡
2 Concealed Vert Rod Exit, Exit Only	7220 B EO (REX) (bronze)	613E	YA ⚡
1 Cylinder (Mortise or Rim as required)	Cylinder to match existing system	613E	YA
2 Surface Closer (bronze)	UNI7500 (brackets and drop plate as	613E	NO

	required)		
1 Astragal	S771C	PE	
1 Gasketing	S88BL (Head & Jambs)	PE	
2 Sweep (bronze)	307DPK	PE	
1 Threshold	273x3AFG MSES10SS	PE	
2 ElectroLynx Harness (frame)	QC-C1500P	MK	⚡
2 ElectroLynx Harness (door)	QC-C*** (Length / Type as Required)	MK	⚡
1 Wiring Diagram	WD-SYSPK (Elevations and Point to Point)	SA	
1 Keyswitch	MKAPZ (sounder)	SU	⚡
1 Power Supply w/ Distribution Board	AQL4-R8E1	SU	⚡

Notes: CARD READER BY SECURITY VENDOR. PRESENTING AUTHORIZED CREDENTIAL TO CARD READER WILL SHUNT ALARM ALLOWING EGRESS BY EXIT DEVICE. USING EXIT DEVICE WITHOUT PRESENTING CREDENTIAL ACTIVATES LOCAL ALARM. KEYSWITCH RESETS ALARM.

Set: 8.0

Doors: 110

3 Hinge, Full Mortise	TA2714	US26D	MK
1 Classroom Lock	MOR 8808FL LC	626	YA
1 Cylinder (Mortise or Rim as required)	Cylinder to match existing system	626	YA
1 Surface Closer	7500 (brackets and drop plate as required)	689	NO
1 Kick Plate	K1050 10" high BEV CSK	US32D	RO
1 Wall/ Floor Stop	RM861 / RM850	US32D	RO
3 Silencer	608		RO

Set: 9.0

Doors: 007B, 007C, 007D, 007E, 007F, 007G, 007H, 007J

3 Hinge, Full Mortise	TA2714	US26D	MK
1 Bathroom Lock (indicator both sides)	MOR 8862FL V21	626	YA
1 Surface Closer	7500 (brackets and drop plate as required)	689	NO

1 Kick Plate	K1050 10" high BEV CSK	US32D	RO
1 Wall/ Floor Stop	RM861 / RM850	US32D	RO
1 Gasketing	S88BL (Head & Jambs)		PE

Set: 10.0

Doors: E103, E110, E118, E120

1 EXISTING TO REMAIN

EXISTING TO REMAIN

OT

END OF SECTION 08 06 71

SECTION 08 12 14 - TRIMLESS DOOR FRAMES

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section including the following.

- 1. Flush steel door frame and flush door

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each product specified.
- B. Shop Drawings: Submit shop drawings showing details of each opening, including elevations, frame profiles, accessories and attachment.

1.3 QUALITY ASSURANCE

- A. Manufacturing: Product manufactured under both ISO9001 and ISO14001 - 2015 EMS policy.
- B. Source Limitations: Obtain metal frames through one source from a single manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Storage and Handling: Comply with manufacturer's recommendations for storage and handling. Protect from weather damage.

1.5 WARRANTY

- A. Warranty: Provide manufacturer's standard limited warranty against defects in manufacturing.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Manufacturer: EzyJamb, www.ezyjamb.com.
- B. Or Approved Equal.

2.2 TRIMLESS INTERIOR DOOR FRAMES

- A. In-Swing Door Frames: EZYJamb Inswing - ISD complying with the following.
 - 1. Material: 18 gauge galvanneal steel, one-piece with perforated flanges.
 - 2. Depth: Suitable for 2-1/4 inch thick doors, and applicable partition thickness.
 - 3. Hardware: See 08 7100 for complete list.
- B.
 - 1. Material: 18 gauge galvanneal steel, one-piece with perforated flanges.
 - 2. Depth: Suitable for 1-3/4 inch thick doors, and applicable partition thickness.
 - 3. Hardware: See 08 7100 for complete list
 - a. Mortised Door Hinges: Rocyork 4-1/2 by 4-1/2 by 0.134 inch with stainless steel (SS) finish.
 - b. Door Strikes: ASA Strike 4-7/8 inches.

2.3 FLUSH FINISH DOOR

- A. Pre-fit Solid Core Flush Primed Hardboard
 - 1. Thickness: 2-1/4"
 - 2. Flat Panel
 - 3. Prepared and rabbeted for flush frame.
 - 4. Hardware: See 08 7100 for complete list.
 - 5. Doors 003 & 004 to receive wallcovering finish on flush side.

2.4 FABRICATION

- A. Fabricate frames and accessories accurately, with true lines and profiles.
- B. Fabricate frames to receive specified hardware.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install trimless door frames in accordance with manufacturer's instructions and approved submittals including the following:
 - 1. Install frames plumb and square.
 - 2. Use door as a template when available to ensure proper alignment and clearances.
 - 3. Install frames securely using fasteners suitable for substrate.
 - 4. Leave frames ready for taping and application of drywall compound.
 - 5. Repair frames damaged during installation.
 - 6. Replace frames which cannot be successfully repaired.
- B. Install accessory products in accordance with manufacturer's instructions and approved submittals including the following:
 - 1. Install products plumb and square.
 - 2. Install products in proper relationship to adjacent construction.
 - 3. Repair products damaged during installation.
 - 4. Replace products which cannot be successfully repaired.

3.3 CLEANING AND PROTECTION

- A. Clean frames as recommended by manufacturer. Protect from damage until acceptance.

END OF SECTION 08 12 14

SECTION 08 14 16 - FLUSH WOOD DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Flush wood doors; flush and flush glazed configuration; fire-rated and non-rated.

1.2 REFERENCE STANDARDS

- A. ASTM E2112 - Standard Practice for Installation of Exterior Windows, Doors and Skylights.
- B. ICC (IBC) - International Building Code.
- C. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.
- D. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives.
- E. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.
- F. UL 10B - Standard for Fire Tests of Door Assemblies.
- G. WDMA I.S. 1A - Interior Architectural Wood Flush Doors.

1.3 SUBMITTALS

- A. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- B. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
- C. Samples for Initial Selection: Submit samples of all standard and custom door veneer options, illustrating wood grain, stain color, and sheen.
- D. Samples for Verification: Submit two samples of door veneer, 12" by 12" inch in size illustrating wood grain, stain color, and sheen.
- E. Test Reports: Show compliance with specified requirements for the following:
 - 1. Sound-retardant doors and frames; sealed panel tests are not acceptable.

- F. Warranty, executed in Owner's name.

1.4 QUALITY ASSURANCE

- A. Maintain one copy of the specified door quality standard on site for review during installation and finishing.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.
 - 1. Company with at least one project within past five years with value of woodwork within at least 20 percent of cost of woodwork for this project.
 - 2. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
- C. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience and approved by manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging, and inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.
- D. Follow Manufacturer's recommendations for product specific delivery, storage and handling requirements.

1.6 WARRANTY

- A. Provide manufacturer's warranty for the life of the installation.
- B. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Wood Veneer Faced Doors:

1. Graham Wood Doors: www.grahamdoors.com
2. Haley Brothers: www.haleybros.com.
3. Marshfield DoorSystems, Inc: www.marshfielddoors.com.
4. VT Industries, Inc: www.vtindustries.com

2.2 DOORS AND PANELS

A. Doors: See drawings for locations and additional requirements.

1. Quality Standard: Custom Grade, Extra Heavy Duty performance, in accordance with WDMA I.S. 1A.
2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.

B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.

1. Provide solid core doors at each location.
2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with $\{rs\#1\}$ or 16 CFR 1201 - Negative (Neutral) Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled.
3. Wood veneer facing with custom finish to match wood paneling to be installed by others.

2.3 DOOR AND PANEL CORES

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.
- B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

2.4 DOOR FACINGS

- A. Veneer Facing for Transparent Finish: Poplar, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face; unless otherwise indicated.
 - 1. Vertical Edges: Any option allowed by quality standard for grade.
 - 2. "Pair Match" each pair of doors; "Set Match" pairs of doors within 10 feet of each other when doors are closed.

2.5 DOOR CONSTRUCTION

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
 - 1. Provide solid blocks at lock edge and top of door for closer for hardware reinforcement.
 - 2. Provide solid blocking for other throughbolted hardware.
- C. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
- D. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- E. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
- F. Provide edge clearances in accordance with the quality standard specified.

2.6 FINISHES - WOOD VENEER DOORS

- A. Finish work in accordance with WDMA I.S. 1A for grade specified and as follows:
 - 1. Transparent:
 - a. Custom: to match wood paneling to be installed by exhibit designers.

- b. Stain: Custom stain; as selected by Architect to match wood paneling to be installed by exhibit designers.
 - c. Sheen: Custom to match wood paneling to be installed by exhibit designers.
- 2. Opaque:
 - a. System - OP-6, Catalyzed Polyurethane.
 - b. Color: As selected by Architect.
 - c. Sheen: Satin.
- B. Factory finish doors in accordance with approved sample and to match wood paneling provided by exhibit designers.
- C. Seal door top edge with color sealer to match door facing.

2.7 ACCESSORIES

- A. Fiberglass Door Frames: See Section 08 16 13.
- B. Glazing: See Section 08 80 00.
- C. Glazing Stops: Wood with metal clips for rated doors, mitered corners; prepared for countersink style tamper proof screws.
- D. Door Hardware: See Section 08 71 00.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.2 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.

1. Install fire-rated doors in accordance with NFPA 80 requirements.
 2. Install smoke and draft control doors in accordance with NFPA 105 requirements.
 3. Install exterior doors in accordance with ASTM E2112.
- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- C. Use machine tools to cut or drill for hardware.
- D. Coordinate installation of doors with installation of frames and hardware.
- E. Coordinate installation of glazing.
- F. Install door louvers plumb and level.

3.3 TOLERANCES

- A. Comply with specified quality standard for fit and clearance tolerances.
- B. Comply with specified quality standard for telegraphing, warp, and squareness.

3.4 ADJUSTING

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.

END OF SECTION 08 14 16

SECTION 08 16 13 - FIBERGLASS FRAMES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fiberglass door frames.

1.2 REFERENCE STANDARDS

- A. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors.
- B. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- D. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
- E. ICC (IBC) - International Building Code.
- F. ITS (DIR) - Directory of Listed Products.
- G. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.
- H. UL (DIR) - Online Certifications Directory.
- I. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies.

1.3 SUBMITTALS

- A. Product Data: Provide manufacturer's standard details, installation instructions, hardware and anchor recommendations.
- B. Shop Drawings: Indicate layout and profiles; include assembly methods.
 - 1. Indicate product components, including hardware reinforcement locations and preparations, accessories, finish colors, patterns, and textures.

2. Indicate wall conditions, door and frame elevations, sections, materials, gauges, finishes, location of door hardware by dimension, and details of openings; use same reference numbers indicated on drawings to identify details and openings.
- C. Selection Samples: Submit two complete sets of color chips, illustrating manufacturer's available finishes, colors, and textures.
- D. Verification Samples: Submit door surface samples for each finish specified, 10 inches by 10 inches in size, illustrating finishes, colors, and textures.
- E. Test Reports: Submit certified test reports from qualified independent testing agency indicating doors comply with specified performance requirements.
- F. Manufacturer's qualification statement.
- G. Installer's qualification statement.
- H. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer; include detailed terms of warranty.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than ten years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Mark doors with location of installation, door type, color, and weight.
- B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Store materials in original packaging, under cover, protected from exposure to harmful weather conditions and from direct contact with water.
 1. Store at temperature and humidity conditions recommended by manufacturer.
 2. Do not use non-vented plastic or canvas shelters.
 3. Immediately remove wet wrappers.

- D. Store in position recommended by manufacturer, elevated minimum 4 inches above grade, with minimum 1/4 inch space between doors.

1.6 FIELD CONDITIONS

- A. Do not install door frames until structure is enclosed.
- B. Maintain temperature and humidity at manufacturer's recommended levels during and after installation of frames.

1.7 WARRANTY

- A. Provide ten (10) year manufacturer warranty covering materials and workmanship , including degradation or failure due to chemical contact.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Fiberglass Frames:

1. Special-Lite: <https://special-lite.com> AF Series
2. ChemPruf Door Company, Ltd: www.chem-pruf.com/#sle.
3. Tiger Door, LLC: www.tigerdoor.com/#sle.
4. or approved equal.

B. Fire-Rated Fiberglass Frames:

1. Plastpro Inc; Fire Rated Series: www.plastproinc.com/#sle.
2. Special-Lite, Inc; Fire Rated Series; AF-FR: www.special-lite.com/#sle.
3. Or approved equal.

2.2 FRAME ASSEMBLIES

A. Frame Assemblies: Factory-fabricated, prepared and machined for hardware.

1. Physical Endurance: Swinging door cycle test to ANSI/SDI A250.4, Level A (1,000,000 cycles) minimum; tested with hardware and fasteners intended for use on project.

2. Screw-Holding Capacity: Tested to 890 pounds, minimum.
 3. Surface Burning Characteristics: Flame spread index (FSI) of 0 to 25, Class A, and smoke developed index (SDI) of 450 or less, when tested in accordance with ASTM E84.
 4. Flammability: Self-extinguishing when tested in accordance with ASTM D635.
 5. Sizes: As indicated on drawings.
 6. Clearance Between Door and Frame: 1/8 inch, maximum.
 7. Clearance Between Bottom of Door and Finished Floor: 3/4 inch, maximum; not less than 1/4 inch clearance to threshold.
 8. Provide frame anchors that allow for variation in rough opening size; field cutting of doors or frames to fit is not permitted.
- B. Fire-Rated Doors and Frames: Comply with fire-ratings as indicated on drawings.
1. Tested in accordance with ICC (IBC) for positive pressure or UL 10C.
 2. ITS (DIR) or UL (DIR) listed and labeled.
 3. Visible seals when doors are open or closed is not permitted.

2.3 COMPONENTS

- A. Door Frames: Provide type in compliance with performance requirements specified for doors.
1. Type: Factory assembled with chemically welded joints.
 2. Profiles: As indicated on drawings.
 3. Color: Seawolf.
 4. Fire-Rated: Provide frames bearing labels to match doors.
 5. Corner Joints: Mitered with concealed corner blocks or angles of same material as frame; fiberglass and aluminum joined with screws; steel and stainless steel spot welded; sealed watertight with silicone sealant; field assemble knock-down type frames as required.

6. Hardware Cut-outs: Provide continuous backing or mortar guards of same material as frame, with watertight seal.
7. Frame Anchors: Stainless steel, Type 304; provide three anchors in each jamb for heights up to 84 inches with one additional anchor for each additional 24 inches in height.
8. Reinforcing: Provide manufacturer's standard reinforcing at hinge, strike, and closer locations.

2.4 PERFORMANCE REQUIREMENTS

- A. Provide door assemblies that have been designed and fabricated in compliance with specified performance requirements.
- B. Water Leakage: No uncontrolled leakage on interior face when tested in accordance with ASTM E331 at differential pressure of 7.5 psf.
- C. Air Leakage: Maximum of 0.1 cfm per square foot at 6.27 psf differential pressure, when tested in accordance with ASTM E283.

2.5 FINISHES

- A. Gel Coating: Ultraviolet (UV) stabilized polyester finish.
 1. Thickness: Minimum 15 mils, 0.015 inch wet thickness, plus/minus 3 mils, 0.003 inch.
 2. Color: Seawolf.

2.6 HARDWARE

- A. Door Hardware: See Sections 08 06 71 and 08 71 00.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify actual dimensions of openings by field measurements before door fabrication; show recorded measurements on shop drawings.
- B. Do not begin installation until substrates have been properly prepared.

3.2 PREPARATION

- A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- B. Clean and prepare substrate in accordance with manufacturer's directions.
- C. Protect adjacent work and finish surfaces from damage during installation.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions; do not penetrate frames with anchors.
- B. Install fire-rated assemblies in accordance with NFPA 80.
- C. Set units plumb, level, and true-to-line, without warping or racking doors, and with specified clearances; anchor in place.
- D. Separate aluminum and other metal surfaces from sources of corrosion of electrolytic action at points of contact with other materials.
- E. Repair or replace damaged installed products.

3.4 ADJUSTING

- A. Lubricate, test, and adjust doors to operate easily, free from warp, twist or distortion, and to fit watertight for entire perimeter.
- B. Adjust hardware for smooth and quiet operation.
- C. Adjust doors to fit snugly and close without sticking or binding.

3.5 CLEANING

- A. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance.

3.6 PROTECTION

- A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION 08 16 13

SECTION 08 31 00 - ACCESS DOORS AND PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wall- and ceiling-mounted access units.

1.2 SUBMITTALS

- A. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- B. Shop Drawings: Indicate exact position of each access door and/or panel unit.
- C. Manufacturer's Installation Instructions: Indicate installation requirements.

PART 2 PRODUCTS

2.1 ACCESS DOORS AND PANELS ASSEMBLIES

- A. Wall-Mounted Units in Wet Areas:

- 1. Location: Provide an access door where access to mechanical, plumbing or electrical item is required behind a fixed wall or ceiling. Coordinate locations with mechanical, plumbing and electrical installations.
- 2. Panel Material: Steel, hot-dipped zinc, or zinc-aluminum-alloy coated.
- 3. Size: 16 by 16 inches minimum, size as required for access; unless otherwise indicated.
- 4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
- 5. Wall Mounting Criteria: Provide surface-mounted face frame and door surface flush with frame surface.

- B. Ceiling-Mounted Units:

- 1. Location: minimum, size as required for access; unless otherwise indicated..
- 2. Panel Material: Steel.

3. Size: 24 by 24 inches minimum, size as required for access; unless otherwise indicated.
4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
- 5.

2.2 WALL- AND CEILING-MOUNTED ACCESS UNITS

A. Manufacturers:

1. ACUDOR Products Inc: www.acudor.com/#sle.
2. Babcock-Davis: www.babcockdavis.com/#sle.
3. Cendrex, Inc: www.cendrex.com/#sle.
4. Milcor, Inc: www.milcorinc.com/#sle.

B. Wall- and Ceiling-Mounted Units: Factory-fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.

1. Door Style: Single thickness with rolled or turned in edges.
2. Frames: 16 gauge, 0.0598 inch, minimum thickness.
3. Double-Skinned Hollow Steel Sheet Door Panels: 16 gauge, 0.059 inch, minimum thickness, on both sides and along each edge.
4. Door Panels to Receive Wall/Ceiling Finish: Surface recessed 5/8 inch back from wall face.
5. Insulation: Non-combustible mineral wool or glass fiber.
6. Steel Finish: Primed.
7. Color: Paint color to be selected by architect to match adjacent surfaces.
8. Hardware:

- a. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that rough openings are correctly sized and located.

3.2 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings, and secure units rigidly in place.
- C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION 08 31 00

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SECTION 08 43 13 - ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Aluminum-framed storefront, with vision glass.
- B. Aluminum doors and frames.
- C. Weatherstripping.

1.2 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site.
- B. AAMA 501.2 - Field Check of Metal Storefronts, Curtain Walls, and Sloped Glazing Systems for Water Leakage.
- C. AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems.
- D. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document).
- E. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
- F. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.
- G. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- H. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- I. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric].
- J. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

- K. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
- L. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
- M. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors.
- N. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.4 SUBMITTALS

- A. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.
- B. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
 - 1. Include design engineer's stamp or seal on shop drawings for attachments and anchors.
- C. Samples: Submit two samples six by six inches in size illustrating finished aluminum surface, glass, glazing materials.
- D. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
- E. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.

- F. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
- G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with strippable coating. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.7 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.8 WARRANTY

- A. Correct defective Work within a five year period after Date of Substantial Completion.
- B. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- C. Provide twenty year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Aluminum-Framed Storefronts:

1. Kawneer North America: www.kawneer.com/#sle.
2. YKK AP America, Inc: www.ykkap.com/commercial/#sle.
3. EFCO: www.efccorp.com.

2.2 ALUMINUM-FRAMED STOREFRONT

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.

1. Glazing Position: Centered (front to back).
2. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep at Storefront 3 (S3) and 2 inches wide by 6 inches deep at Storefront S1 and S2.
3. Finish: at Storefront S1 and Storefront S2: Class I natural anodized, at Storefront S3: Class 1 color anodized.
 - a. Factory finish all surfaces that will be exposed in completed assemblies.
 - b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
4. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
5. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
6. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.

7. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
8. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
9. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

B. Performance Requirements

1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
 - a. Design Wind Loads: Comply with requirements of ASCE 7.
 - b. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
2. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 8 psf.
3. Air Leakage: 0.06 cfm/sq ft maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 1.57 psf pressure difference.
4. Thermal Resistance (U Factor)
 - a. System: 0.38 maximum
 - b. Door: 0.77 maximum

2.3 COMPONENTS

- A. Aluminum Framing Members:** Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.

1. Glazing Stops: Flush.
- B. Glazing: See Section 08 80 00.
- C. Infill Panels: Insulated, aluminum, with edges formed to fit glazing channel and sealed.
 1. Total Nominal Thickness: 1 inch.
 2. Finish: Same as storefront.
 3. Exterior Finish: Class I color anodized.
 4. Interior Finish: Class I color anodized.
- D. Swing Doors: Glazed aluminum.
 1. Thickness: 1-3/4 inches.
 2. Top Rail: 6 inches wide.
 3. Vertical Stiles: 6 inches wide.
 4. Bottom Rail: 10 inches wide.
 5. Glazing Stops: Square.
 6. Finish: Same as storefront.
 7. U-Value: 0.77 maximum.

2.4 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Sheet Aluminum: ASTM B209/B209M.
- C. Fasteners: Stainless steel.
- D. Exposed Flashings: Aluminum sheet, 20 gauge, 0.032 inch minimum thickness; finish to match framing members.
- E. Concealed Flashings: Galvanized steel, 26 gauge, 0.0179 inch minimum base metal thickness.

- F. Sill Flashing Sealant: Elastomeric, silicone or polyurethane, compatible with flashing material.
- G. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

2.5 FINISHES

- A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.
- B. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42 Integrally colored anodic coating not less than 0.7 mils thick.

2.6 HARDWARE

- A. Other Door Hardware: See Section 08 71 00.
- B. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that storefront wall openings and adjoining water-resistive and/or air barrier seal materials are ready to receive work of this section.

3.2 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.

- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- I. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.3 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inch per 3 feet non-cumulative or 0.06 inch per 10 feet, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.4 FIELD QUALITY CONTROL

- A. Water-Spray Test: Provide water spray quality test of installed storefront components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.
 - 1. Perform a minimum of two tests in each designated area as directed by Architect.
 - 2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.
- B. Provide field testing of installed storefront system by independent laboratory in accordance with AAMA 503 during construction process and before installation of interior finishes.
 - 1. Perform a minimum of two tests in each designated area as directed by Architect.
 - 2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.
 - 3. Field test for water penetration in accordance with ASTM E1105 with uniform static air pressure difference (Procedure A) not less than 4.18 psf.

- a. Maximum allowable rate of water penetration in 15-minute test is 0.5 ounce that is not contained in an area with provisions to drain to exterior, or collected on surface of interior horizontal framing member.
- 4. Field test for air leakage in accordance with ASTM E783 with uniform static air pressure difference of 1.57 psf.
- C. Repair or replace storefront components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.5 ADJUSTING

- A. Adjust operating hardware for smooth operation.

3.6 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.
- C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.7 PROTECTION

- A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION 08 43 13

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SECTION 08 44 13 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Aluminum-framed curtain wall, with vision glazing and glass infill panels.
- B. Firestopping between curtain wall and edge of floor slab.

1.2 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site.
- B. AAMA 501.2 - Field Check of Metal Storefronts, Curtain Walls, and Sloped Glazing Systems for Water Leakage.
- C. AAMA 501.4 - Recommended Static Test Method for Evaluating Curtain Wall and Storefront Systems Subjected to Seismic and Wind Induced Interstory Drifts.
- D. AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems.
- E. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document).
- F. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
- G. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.
- H. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
- I. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- J. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- K. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric].

- L. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer.
- M. ASTM C793 - Standard Test Method for Effects of Laboratory Accelerated Weathering on Elastomeric Joint Sealants.
- N. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
- O. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems.
- P. ASTM C1135 - Standard Test Method for Determining Tensile Adhesion Properties of Structural Sealants.
- Q. ASTM C1184 - Standard Specification for Structural Silicone Sealants.
- R. ASTM C1249 - Standard Guide for Secondary Seal for Sealed Insulating Glass Units for Structural Sealant Glazing Applications.
- S. ASTM C1401 - Standard Guide for Structural Sealant Glazing.
- T. ASTM C1401 - Standard Guide for Structural Sealant Glazing
- U. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- V. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors
- W. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.
- X. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic").

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.4 SUBMITTALS

- A. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, internal drainage details, glazing, and infill.
- B. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required. Submit signed and sealed shop drawings.
- C. Shop Drawings: Provide details of proposed structural sealant glazing (SSG) and weather sealant joints indicating dimensions, materials, bite, thicknesses, profile, and support framing.
- D. Samples: Submit two samples 2 by 6 inches in size illustrating finished aluminum surface, and infill panels,.
- E. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
- F. Design Data: Provide framing member structural and physical characteristics and engineering calculations, and identify dimensional limitations; include load calculations at points of attachment to building structure. Submit signed and sealed calculations.
- G. Structural Sealant Glazing (SSG): Submit product data and calculations showing compliance with performance requirements.
- H. Test Reports: Submit results of full-size mock-up testing. Reports of tests previously performed on the same design are acceptable.
- I. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
- J. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Designer Qualifications: Design curtain wall and its structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed at the State in which the Project is located.

- B. Verify that each component is appropriate for use in structural sealant glazing (SSG) application in regards to at least the following properties; size, shape, dimensions, material, self-life, storage conditions, and color.
- C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than three years of documented experience.
- D. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
- E. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.7 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.8 WARRANTY

- A. Correct defective Work within a two year period after Date of Substantial Completion.
- B. Provide twenty year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Kawneer Clearwall Curtain Wall System: www.kawneer.com .

B. Other Acceptable - Provide either the product identified as the Basis of Design or an equivalent product of one of the manufacturers listed below:

1. YKK AP America, Inc: www.ykkap.com/commercial/#sle.

2.2 CURTAIN WALL

A. Aluminum-Framed Curtain Wall: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.

1. Structural sealant glazing (SSG) adhesive on four (4)-sides, with temporary glazing stops, where indicated on drawings.
2. Glazing Method: Field glazed system.
3. Finish: Interior Mullions to be Class 1 color anodized - Dark Bronze.
 - a. Factory finish surfaces that will be exposed in completed assemblies.
 - b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
 - c. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
4. Provide flush joints and corners, weathersealed, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.
5. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
6. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
7. Maintain continuous air barrier and/or vapor retarder seal throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel and heel bead of glazing compound.
8. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

- B. Structural Performance Requirements: Design and size components to withstand the following load requirements without damage or permanent set. Any steel reinforcing required inside the mullions based on the design, shall be included.
 - 1. Design Wind Loads: Comply with requirements of ASCE 7
 - 2. Interstory Differential Lateral Movement: Meeting pass/fail criteria of AAMA 501.4 for Use Group I, Standard Occupancy, when tested at design displacement of 0.010 times greater adjacent story height, maximum, and 1.5 times design displacement, through three complete cycles.
 - 3. Movement: Accommodate the following movement without damage to components or deterioration of seals:
 - a. Expansion and contraction caused by 180 degrees F surface temperature.
 - b. Expansion and contraction caused by cycling temperature range of 170 degrees F over a 12 hour period.
 - c. Movement of curtain wall relative to perimeter framing.
 - d. Deflection of structural support framing, under permanent and dynamic loads.
 - 4. Structural Sealant Glazing (SSG) System: For individual glass lites, design framing members to not exceed a deflection normal to the wall of L/175 between supports with 3/4 inch maximum, and a deflection parallel to the wall of L/360 with 1/8 inch maximum, whichever is less.
- C. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on indoor face when tested as follows:
 - 1. Test Pressure Differential: 10 psf.
- D. Air Leakage: 0.06 cfm/sq ft maximum leakage of wall area when tested in accordance with ASTM E283/E283M at 6.27 psf pressure difference across assembly.
- E. Thermal Performance Requirements:
 - 1. Condensation Resistance Factor of Framing: 50, minimum, measured in accordance with AAMA 1503.
 - 2. Thermal Resistance of System: (U-factor): 0.38 maximum.

2.3 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
 - 1. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.
- B. Glazing: See Section 08 80 00.

2.4 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Sheet Aluminum: ASTM B209/B209M.
- C. Structural Steel Sections: ASTM A36/A36M; shop primed.
- D. Structural Supporting Anchors Attached to Structural Steel: Design for bolted attachment.
- E. Fasteners: Stainless steel; type as required or recommended by curtain wall manufacturer.
- F. Exposed Flashings: Aluminum sheet, 20 gauge, 0.032 inch minimum thickness; finish to match framing members.
- G. Concealed Flashings: Stainless steel, 26 gauge, 0.0187 inch minimum thickness.
- H. Firestopping: See Section 07 84 00.
- I. Structural Sealant Glazing (SSG) Adhesive: Neutral curing, silicone sealant formulated for SSG applications in compliance with ASTM C1184 and structural glazing industry guidelines, ASTM C1401.
 - 1. SSG adhesive in compliance with ASTM C920; Type S - Single-component, Grade NS, Class 50, Use NT, G, and A.
 - 2. Ultimate Tensile Strength: Minimum of 50 psi as determined by test method ASTM C1135 under the following conditions.
 - a. Exposure to air temperatures of 190 degrees F and minus 20 degrees F.

- b. Water immersion for seven (7) days, minimum.
 - c. Exposure to weathering for 5,000 hours, minimum.
- 3. Sealant Design Tensile Strength: 20 psi, maximum.
- 4. Hardness: 20 to 60 with Type A-2 durometer in compliance with test method ASTM C661.
- 5. Shelf Life: Six (6) months, minimum.
- 6. Color: Black.
- 7. SSG sealant tested for compatibility with glazing accessories in compliance with ASTM C1087, tested for accelerated weathering in compliance with ASTM C793, and in compliance with insulating glass secondary sealant design standards of ASTM C1249.
- J. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
- K. Glazing Accessories: See Section 08 80 00.
- L. Shop and Touch-Up Primer for Steel Components: Zinc oxide, alkyd, linseed oil primer appropriate for use over hand cleaned steel.
- M. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20, zinc rich.

2.5 FINISHES

- A. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42 Integrally colored anodic coating not less than 0.7 mils thick. Color to match architect's sample.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other related work.
- B. Verify that curtain wall openings and adjoining water-resistive and air barrier seal materials are ready to receive work of this section.
- C. Verify that anchorage devices have been properly installed and located.

3.2 INSTALLATION

- A. Install curtain wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Coordinate attachment and seal of perimeter air and vapor barrier materials.
- H. Install firestopping at each floor slab edge.
- I. Provide insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- J. Structural Sealant Glazing (SSG) Adhesive: Install structural sealant glazing adhesive and weatherseal sealant in accordance with manufacturer's instructions.
- K. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.3 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 0.5 inches per 100 ft, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.
- C. Sealant Space Between Curtain Wall Mullions and Adjacent Construction: Maximum of 3/4 inch and minimum of 1/4 inch.

3.4 FIELD QUALITY CONTROL

- A. Provide services of curtain wall manufacturer's field representative to observe for proper installation of system and submit report.
- B. See Section 01 40 00 - Quality Requirements for independent field testing and inspection requirements, and requirements for monitoring quality of specified product installations.
- C. Water-Spray Test: Provide water spray quality test of installed curtain wall components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.
 - 1. Perform a minimum of two tests in each designated area as indicated on drawings.
 - 2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.
- D. Provide field testing of installed curtain wall system by independent laboratory in accordance with AAMA 503 during construction process and before installation of interior finishes.
 - 1. Perform a minimum of two tests in each designated area as indicated on drawings.
 - 2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.
 - 3. Field test for water penetration in accordance with ASTM E1105 with uniform static air pressure difference (Procedure A) not less than 4.18 psf.
 - a. Maximum allowable rate of water penetration in 15-minute test is 0.5 ounce that is not contained in an area with provisions to drain to exterior, or collected on surface of interior horizontal framing member.
- E. Repair or replace curtain wall components that have failed designated field testing, and retest to verify performance complies with specified requirements.
- F. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- G. Test Area: Perform tests on one bay at least 30 feet (9.1 m), by one story.

- H. Structural-Sealant Adhesion: Test structural sealant according to recommendations in ASTM C 1401, Destructive Test Method A, "Hand Pull Tab (Destructive)," Appendix X2.
 - 1. Test a minimum of two areas on each building facade.
 - 2. Repair installation areas damaged by testing.
- I. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.
- J. Prepare test and inspection reports.

3.5 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, take care to remove dirt from corners, and wipe surfaces clean.
- C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.6 PROTECTION

- A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION 08 44 13

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SECTION 08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes commercial door hardware for the following:
 - 1. Swinging doors.
 - 2. Other doors to the extent indicated.
- B. Door hardware includes, but is not necessarily limited to, the following:
 - 1. Mechanical door hardware.
 - 2. Electromechanical door hardware.
 - 3. Automatic operators.
 - 4. Cylinders specified for doors in other sections.
- C. Related Sections:
 - 1. Division 08 Section "Flush Wood Doors".
 - 2. Division 08 Section "Aluminum-Framed Entrances and Storefronts".
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
 - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 - 2. ICC/IBC - International Building Code.
 - 3. NFPA 70 - National Electrical Code.
 - 4. NFPA 80 - Fire Doors and Windows.
 - 5. NFPA 101 - Life Safety Code.
 - 6. NFPA 105 - Installation of Smoke Door Assemblies.
 - 7. UL/ULC and CSA C22.2 - Standards for Automatic Door Operators Used on Fire and Smoke Barrier Doors and Systems of Doors.
 - 8. State Building Codes, Local Amendments.
- E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:
 - 1. ANSI/BHMA Certified Product Standards - A156 Series.

2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
3. ANSI/UL 294 - Access Control System Units.
4. UL 305 - Panic Hardware.
5. ANSI/UL 437- Key Locks.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
 2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
 3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.
 - h. Warranty information for each product.
 4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Shop Drawings: Details of electrified access control hardware indicating the following:
 1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

- a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
 - b. Complete (risers, point-to-point) access control system block wiring diagrams.
 - c. Wiring instructions for each electronic component scheduled herein.
 2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.
- D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
- E. Informational Submittals:
1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

1.4 CLOSEOUT SUBMITTALS

- A. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.
- B. Project Record Documents: Provide record documentation of as-built door hardware sets in digital format (.pdf, .docx, .xlsx, .csv) and as required in Division 01, Project Record Documents.

1.5 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. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).
- C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that

indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

- E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
 - 1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
 - 2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.
- F. Each unit to bear third party permanent label indicating compliance with the referenced testing 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 according to manufacturer's instructions and recommendations and according to approved schedule.

1.6 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".

1.7 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 and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.8 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. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 BUTT HINGES

- A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.
1. Quantity: Provide the following hinge quantity:
 - a. Two Hinges: For doors with heights up to 60 inches.
 - b. Three Hinges: For doors with heights 61 to 90 inches.
 - c. Four Hinges: For doors with heights 91 to 120 inches.
 - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
 2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
 - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
 - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
 3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
 - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
 - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
 4. Hinge Options: Comply with the following:
 - a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for all out-swinging lockable doors.
 5. Manufacturers:
 - a. Hager Companies (HA) - BB Series, 5-knuckle.
 - b. McKinney (MK) - TA/T4A Series, 5-knuckle.
 - c. dormakaba BEST (ST) - F/FBB Series, 5-knuckle.

2.2 CONTINUOUS HINGES

- A. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 continuous geared hinge. with minimum 0.120-inch thick extruded 6063-T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.
1. Manufacturers:.

- a. Hager Companies (HA).
- b. Pemko (PE).
- c. dormakaba BEST (ST).

2.3 POWER TRANSFER DEVICES

- A. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:

- a. Pemko (PE) - EL-CEPT Series.
- b. Securitron (SU) - EL-CEPT Series.

- B. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

1. Provide one each of the following tools as part of the base bid contract:

- a. McKinney (MK) - Electrical Connecting Kit: QC-R001.
- b. McKinney (MK) - Connector Hand Tool: QC-R003.

2. Manufacturers:

- a. McKinney (MK) - QC-C Series.

2.4 DOOR OPERATING TRIM

- A. Flush Bolts and Surface Bolts: Provide products conforming to ANSI/BHMA A156.3 and A156.16, Grade 1.

- 1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
- 2. Furnish dust proof strikes for bottom bolts.
- 3. Surface bolts to be minimum 8" in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
- 4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.

5. Manufacturers:
 - a. Door Controls International (DC).
 - b. Rockwood (RO).
 - c. Trimco (TC).
- B. Coordinators: ANSI/BHMA A156.3 door coordinators consisting of active-leaf, hold-open lever and inactive-leaf release trigger. Model as indicated in hardware sets.
 1. Manufacturers:
 - a. Door Controls International (DC).
 - b. Rockwood (RO).
 - c. Trimco (TC).
- C. Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.
 1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
 2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
 3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
 4. Pulls, where applicable, shall be provided with a 10" clearance from the finished floor on the push side to accommodate wheelchair accessibility.
 5. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets. When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
 6. Manufacturers:
 - a. Hiawatha, Inc. (HI).
 - b. Rockwood (RO).
 - c. Trimco (TC).

2.5 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
 1. Manufacturers:
 - a. Match Existing, Field Verify.
- B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:

1. Threaded mortise cylinders with rings and cams to suit hardware application.
2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
4. Tubular deadlocks and other auxiliary locks.
5. 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.
6. Keyway: Match Facility Standard.

C. Keying System: Each type of lock and cylinders to be factory keyed.

1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
3. Existing System: Field verify and key cylinders to match Owner's existing system.

D. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Two (2)
2. Master Keys (per Master Key Level/Group): Five (5).

E. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

2.6 MORTISE LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): Provide ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed mortise locksets. Listed manufacturers shall meet all functions and features as specified herein.

1. Manufacturers:
 - a. ASSA ABLOY ACCENTRA, formerly known as Yale (YA) - 8800FL Series.
 - b. Or Approved Equal.

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.
4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.8 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. Exit devices shall have a five-year warranty.
2. 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.
3. 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.
4. 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.
5. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
 - a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
 - b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
7. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
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 Products Directory (CPD) listed exit devices. Listed manufacturers shall meet all functions and features as specified herein.
 - 1. Electromechanical exit devices shall have the following functions and features:
 - a. Universal Molex plug-in connectors that have standardized color-coded wiring and are field configurable in fail safe or fail secure and operate from 12vdc to 24vdc regulated.
 - b. EcoFlex or equivalent technology that reduces energy consumption up to 92% as certified by GreenCircle.
 - c. Options to be available for request-to-exit or enter signaling, latchbolt and touchbar monitoring.
 - d. Field configurable electrified trim to fail-safe or fail-secure that operates from 12-24VDC.
 - e. Five-year limited warranty for electromechanical features.
 - 2. Manufacturers:
 - a. ASSA ABLOY ACCENTRA, formerly known as Yale (YA) - 7000 Series.
 - b. Or Approved Equal.

2.9 SURFACE 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.
 - 2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
 - 3. 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 Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
 - 4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
 - 5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
 - 6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.
- B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed 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. Heavy duty surface mounted door closers shall have a 30-year warranty.
2. Manufacturers:
 - a. Norton Rixson (NO) - 7500 Series.
 - b. Or Approved Equal.

2.10 ELECTROHYDRAULIC DOOR OPERATORS

- A. Electrohydraulic Door Operators (High Traffic): Provide ANSI/BHMA A156.19 Certified Products Directory (CPD) listed low energy operators that meet ANSI/BHMA A156.4 requirements and are UL listed for use on fire rated doors and UL10C certified that comply with requirements for the Americans with Disabilities Act (ADA). Operators shall be verified by GreenCircle to offer energy savings of 19% when compared to similar products to accommodate openings up 250 pounds and 48" wide.

1. Provide operators with features as follows:
 - a. Non-handed with push and pull side mounting.
 - b. Operates as mechanical surface closer during close cycles, when door is opened manually or if power is off.
 - c. Activation by push button, hands-free or radio frequency devices.
 - d. On board electronics to collect usage and cycle count data to facilitate preventative maintenance/diagnostics.
 - e. Two-year limited warranty.
 - f. Wi-Fi interface where the operator is a secure, password protected WiFi hot spot with no connection to building's IT required.
 - 1) Simple setup with no app required.
 - 2) View status and make adjustments without removing the cover.
 - 3) Built-in logic to support single use restroom applications with no external relay boards, logic modules, position switches required.
 - g. Mounting backplate to simplify and speed up installation.
2. Operators shall have the following functionality:
 - a. Adjustable Hold Open: Amount of time a door will stay in the full open position after an activation.
 - b. Blow Open for Smoke Ventilation: Door opens when signal is received from alarm system allowing air or smoke to flow through opening. Door will stay open until signal from alarm system is stopped.
 - c. Infinite Hold Open: Door will hold open at set position until power is turned off.
 - d. Obstruction Detection: Door closes if it hits an obstruction while opening; door will reverse to open position if it hits an obstruction while closing. Door will stop once it hits an obstruction and will rest against the obstruction until removed.
 - e. Open Delay: Delays operator opening for locking hardware.

- f. Overload Safety Shut-Off: After two minutes of receiving a door activation signal, inverter times out and door closes to prevent motor/inverter damage.
 - g. Presence Detector Input: Input for external sensor to detect presence at door open or close position only.
 - h. Push & Go: As the door is manually opened, the operator "senses" movement and opens door to the full-open position.
 - i. Selector Mode Switch: Off disables the signal inputs unless Blow Open is activated, on activates the signal inputs, hold open activates the unit (unless Blow Closed is activated) to the hold open position.
 - j. Vestibule Delay: When the wall switch is pressed, first door in vestibule will open. Second door will open once vestibule door delay has expired. Delay is adjustable.
3. Manufacturers:
- a. Norton Rixson (NO) - 6000 Series.
 - b. Or Approved Equal.

2.11 SURFACE MOUNTED CLOSER HOLDERS

- A. Electromagnetic Door Holders: ANSI A156.15 electromagnetic door holder/releases with a minimum 20 to 40 pounds holding power and single coil construction able to accommodate 12VDC, 24VAC, 24VDC and 120VAC. Coils to be independently wound, employing an integral fuse and armatures to include a positive release button.

1. Manufacturers:
- a. Norton Rixson (RF) - 980/990 Series.
 - b. Or Approved Equal.

2.12 ARCHITECTURAL TRIM

- A. Door Protective Trim

- 1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
- 2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
- 3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
- 4. Protection Plates: ANSI/BHMA A156.6 protection plates (kick, armor, or mop), fabricated from the following:
 - a. Stainless Steel: 300 grade, .050-inch thick.

5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
6. Manufacturers:
 - a. Hiawatha, Inc. (HI).
 - b. Rockwood (RO).
 - c. Trimco (TC).

2.13 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 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
 1. Manufacturers:
 - a. Hiawatha, Inc. (HI).
 - b. Rockwood (RO).
 - c. Trimco (TC).
- C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed 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. Manufacturers:
 - a. Norton Rixson (RF).
 - b. Rockwood (RO).
 - c. Sargent Manufacturing (SA).

2.14 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 NFPA 252, Standard Methods of Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Manufacturers:
 1. National Guard Products (NG).
 2. Pemko (PE).
 3. Reese Enterprises, Inc. (RE).

2.15 ELECTRONIC ACCESSORIES

- A. Key Switches: Key switches furnished standard with stainless steel single gang face plate with a 12/24VDC bi-color LED indicator. Integral backing bracket permits integration with any 1 1/4" or 1 1/2" mortise type cylinder. Key switches available as momentary or maintained action and in narrow face plate options.
 1. Manufacturers:
 - a. Alarm Controls (AK) - MCK Series.
 - b. Security Door Controls (SD) - 800 Series.
 - c. Securitron (SU) - MK Series.
- B. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap-lock into a 1" diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide SPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.
 1. Manufacturers:
 - a. Sargent Manufacturing (SA) - 3280 Series.
 - b. Security Door Controls (SD) - DPS Series.
 - c. Securitron (SU) - DPS Series.

- C. Intelligent Switching Power Supplies: Provide power supplies with single, dual or multi-voltage configurations at 12 and/or 24VDC. Power Supply shall have battery backup function with an integrated battery charging circuit. The power supply shall have a standard, integrated Fire Alarm Interface (FAI). The power supply shall provide capability for secondary voltage, power distribution, direct lock control and network monitoring through add on modules. The power supply shall be expandable up to 16 individually protected outputs. Output modules shall provide individually protected, continuous outputs and/or individually protected, relay controlled outputs. Network modules shall provide remote monitoring functions such as status reporting, fault reporting and information logging.
 - 1. 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.
 - 2. Manufacturers:
 - a. Securitron (SU) - AQL Series.
 - b. Or Approved Equal.

2.16 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.

2.17 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. DHI TDH-007-20: Installation Guide for Doors and Hardware.
 - 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. Push Plates and Door Pulls: When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
- E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- F. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.
 - 1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

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. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
 - 1. Quantities listed are for each pair of doors, or for each single door.
 - 2. The supplier is responsible for handing and sizing all products.

3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
 4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.
- B. Refer to Section 080671, Door Hardware Sets, for hardware sets.

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SECTION 08 80 00 - GLAZING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Insulating glass units.
- B. Glazing units.
- C. Glazing compounds.

1.2 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials.
- B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test.
- C. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.
- D. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
- E. ASTM C1036 - Standard Specification for Flat Glass.
- F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.
- G. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass.
- H. ASTM C1193 - Standard Guide for Use of Joint Sealants.
- I. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass.
- J. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings.
- K. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation.
- L. GANA (GM) - GANA Glazing Manual.

- M. GANA (SM) - GANA Sealant Manual.
- N. GANA (LGRM) - Laminated Glazing Reference Manual.
- O. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use.
- P. NFRC 100 - Procedure for Determining Fenestration Product U-factors.
- Q. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence.
- R. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems.

1.3 SUBMITTALS

- A. Product Data on Insulating Glass Unit and Glazing Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
- B. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
- C. Samples: Submit two samples 12 by 12 inch in size of glass units.
- D. Certificate: Certify that products of this section meet or exceed specified requirements.
- E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA (GM), GANA (SM), GANA (LGRM), and IGMA TM-3000 for glazing installation methods. Maintain one copy on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

1.5 FIELD CONDITIONS

- A. Do not install glazing when ambient temperature is less than 40 degrees F.
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.6 WARRANTY

- A. Insulating Glass Units: Provide a five (5) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.
- B. Laminated Glass: Provide a five (5) year manufacturer warranty to include coverage for delamination, including providing products to replace failed units.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Glass Manufacturers:
 - 1. Guardian Glass, LLC: www.guardianglass.com
 - 2. Pilkington North America Inc: www.pilkington.com/na/#sle.
 - 3. Vitro Architectural Glass (formerly PPG Glass): www.vitroglazings.com
- B. Bird-Friendly Glass Manufacturers:
 - 1. Guardian Glass, LLC: www.guardianglass.com/#sle.
 - 2. ORNILUX Bird Protection Glass, developed by ARNOLD GLAS
: www.ornilux.com/#sle.
 - 3. Walker Glass Company Ltd: www.walkerglass.com/#sle.

2.2 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

- A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
 - 1. Design Pressure: Calculated in accordance with ASCE 7.

2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
 3. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
 4. Glass thicknesses listed are minimum.
- B. Weather-Resistive Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure water-resistive barrier, vapor retarder, and/or air barrier.
1. In conjunction with weather barrier related materials described in other sections, as follows:
 2. To maintain a continuous vapor retarder and/or air barrier throughout glazed assembly from glass pane to heel bead of glazing sealant.
- C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
 2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
 3. Solar Optical Properties: Comply with NFRC 300 test method.

2.3 GLASS MATERIALS

- A. Float Glass: Provide float glass based glazing unless otherwise indicated.
1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
 2. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048.
 3. Kind FT - Fully Tempered Type: Complies with ASTM C1048.

4. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.

B. Laminated Glass: Float glass laminated in accordance with ASTM C1172.

1. Laminated Safety Glass: Complies with ANSI Z97.1 - Class A or 16 CFR 1201 - Category II impact test requirements.
2. Polyvinyl Butyral (PVB) Interlayer: 0.030 inch thick, minimum.

2.4 INSULATING GLASS UNITS

A. Manufacturers:

1. Guardian Glass, LLC: www.guardianglass.com
2. Pilkington North America Inc: www.pilkington.com/na
3. Viracon, Apogee Enterprises, Inc: www.viracon.com
4. Vitro Architectural Glass (formerly PPG Glass): www.vitroglazings.com
5. Oldcastle Building Envelope: www.obe.com.

B. Insulating Glass Units: Types as indicated.

1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
3. Spacer Color: Black.
4. Edge Seal:
 - a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone sealant as secondary seal applied around perimeter.
5. Color: Black.

6. Purge interpane space with dry air, hermetically sealed.
- C. Type[GL-2]- Insulating Glass Units: Etched glazing.
1. Applications: Exterior etched glazing unless otherwise indicated..
 2. Space between lites filled with air.
 3. Outboard Lite: Annealed float glass, 1/4 inch thick.
 - a. Tint: Clear.
 - b. Coating: Etch (2x2 dot pattern, nondirectional), on #1 surface.
 - 1) Basis of Design Product: Guardian Glass, Bird 1st - Etch DX22 Clear
 - c. Coating: Low-E, triple silver coating, on #2 surface.
 - 1) Basis of Design Product: Guardian Glass, SunGuard SNX 62/27
 4. Metal edge spacer.
 5. Inboard Lite: Annealed float glass, 1/4 inch thick, minimum.
 - a. Tint: Clear.
 6. Total Thickness: 1 inch.
 7. Thermal Transmittance (U-Value), Winter - Center of Glass: .286, minimum.
 8. Visible Light Transmittance (VLT): 62 percent, nominal.
 9. Solar Heat Gain Coefficient (SHGC): .27, maximum.
- D. Type GL-1 - Insulating Glass Units: Etched glazing.
1. Applications: Exterior etched glazing unless otherwise indicated..
 2. Space between lites filled with air.
 3. Outboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
 - a. Tint: Clear.
 - b. Coating: Etch (2x2 dot pattern, non-directional), on #1 surface.

- 1) Basis of Design Product: Guardian Glass, Bird 1st - Etch DX22 Clear
- c. Coating: Low-E, triple silver coating, on #2 surface.
 - 1) Basis of Design Product: Guardian Glass, SunGuard SNX 62/27
4. Metal edge spacer.
5. Inboard Lite: Heat-strengthened float glass, 1/4 inch thick, minimum.
 - a. Tint: Clear.
6. Total Thickness: 1 inch.
7. Thermal Transmittance (U-Value), Winter - Center of Glass: .286, minimum.
8. Visible Light Transmittance (VLT): 62 percent, nominal.
9. Solar Heat Gain Coefficient (SHGC): .27, nominal.
- E. Type [GL-4]: Opaque Infill Panel
 1. Application: Aluminum Storefront
 2. Basis of Design: Mapes R - Infill Panel
 3. Outboard Lite: Class 1 Dark Bronze Anodized; Standard Thickness: .040"
 4. Inboard Lite: Class 1 Dark Bronze Anodized; Standard Thickness: .040"
 5. Total Thickness: 1/2 inch
 6. Thermal Transmittance: R-Value:
 7. Insulating Core:

2.5 GLAZING UNITS

- A. Type GL-3 - Fire Protection Rated Glazing: Type, thickness, and configuration of glazing that contains flame, smoke and does not block radiant heat, as required to achieve fire-doors indicated fire-rating period of 90 minutes or less.
 1. Applications: Glazing in fire rated door assemblies.

2. Markings for Fire Protection Rated Glazing Assemblies : Provide permanent markings on fire-protection rated glazing in compliance with 1, local building code, and authorities having jurisdiction.

2.6 GLAZING COMPOUNDS

A. Manufacturers:

1. Bostik Inc: www.bostik-us.com
2. Dow Corning Corporation: www.dowcorning.com/construction/#sle.
3. Momentive Performance Materials, Inc: www.momentive.com/#sle.
4. Pecora Corporation: www.pecora.com

2.7 ACCESSORIES

- A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch by width of glazing rabbet space minus 1/16 inch by height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.
- C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.
- D. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.
- E. Glazing Clips: Manufacturer's standard type.

PART 3 EXECUTION

3.1 VERIFICATION OF CONDITIONS

- A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

- B. Verify that the minimum required face and edge clearances are being provided.
- C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.
- D. Verify that sealing between joints of glass framing members has been completed effectively.
- E. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.3 INSTALLATION, GENERAL

- A. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.
- B. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.
- C. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.
- D. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.
- E. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, etc.

3.4 INSTALLATION - STRUCTURAL SILICONE GLAZING

- A. Application - Factory (Shop) Glazed: Follow basic guidelines of structural silicone glazing for glazing application.

1. Four-Sided Structural: Glass with four sides structurally adhered to horizontal and vertical metal back-up mullion.
- B. Provide design review of the glazing system and project details, adhesion testing, proper surface preparation, training and a quality service program.
- C. Provide only structural silicone sealant, tested and manufactured for structural glazing.

3.5 FIELD QUALITY CONTROL

- A. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.
- B. Monitor and report installation procedures and unacceptable conditions.

3.6 CLEANING

- A. See Section 01 74 19 - Construction Waste Management and Disposal, for additional requirements.
- B. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
- C. Remove nonpermanent labels immediately after glazing installation is complete.
- D. Clean glass and adjacent surfaces after sealants are fully cured.
- E. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.7 PROTECTION

- A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.
- B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION 08 80 00

SECTION 08 91 00 - LOUVERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Louvers, frames, and accessories.

1.2 REFERENCE STANDARDS

- A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
- B. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- C. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating.
- D. AMCA 511 - Certified Ratings Program for Air Control Devices.
- E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric].

1.3 SUBMITTALS

- A. Product Data: Provide data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.
- B. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, and tolerances; head, jamb and sill details; blade configuration, screens, blank-off areas required, and frames.
- C. Samples: Submit two samples 2 by 2 inches in size illustrating finish and color of exterior and interior surfaces.
- D. Test Reports: Independent agency reports showing compliance with specified performance criteria.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.

1.5 WARRANTY

- A. Provide five year manufacturer's warranty against distortion, metal degradation, and connection failures of louver components.
 - 1. Finish: Include twenty year coverage against degradation of exterior finish.

PART 2 PRODUCTS

2.1 LOUVERS

- A. Louvers: Factory fabricated and assembled, complete with frame, mullions, and accessories; AMCA Certified in accordance with AMCA 511.
 - 1. Wind Load Resistance: Design to resist positive and negative wind load of 25 psf without damage or permanent deformation.
 - 2. Intake Louvers: Design to allow maximum of 0.01 oz/sq ft water penetration at calculated intake design velocity based on design air flow and actual free area, when tested in accordance with AMCA 500-L.
 - 3. Drainable Blades: Continuous rain stop at front or rear of blade aligned with vertical gutter recessed into both jambs of frame.
- B. Stationary Louvers, Type LV1 & LV2: inverted "v" blade, extruded aluminum construction, with intermediate mullions matching frame.
 - 1. Free Area: 50 percent, minimum.
 - 2. Frame: 6 inches deep, channel profile; corner joints , with continuous recessed caulking channel each side.
 - 3. Aluminum Thickness: Frame 12 gauge, 0.0808 inch minimum; blades 12 gauge, 0.0808 inch minimum.
 - 4. Finish: Polyvinylidene fluoride coating, finish welded units after fabrication.
 - 5. Color: Custom, to match approved sample.

2.2 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Polyvinylidene Fluoride Coating: Minimum 70 percent Kynar 500/Hylar 500 resin, two coat finish, complying with AAMA 2604.
- C. Primer: Zinc chromate, alkyd type.

2.3 FINISHES

- A. Superior Performing Organic Coatings System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of 1.2 mils, 0.0012 inch.

2.4 ACCESSORIES

- A. Blank-Off Panels: Same material as louver, painted black on exterior side; provide where duct connected to louver is smaller than louver frame, sealing off louver area outside duct.
- B. Blank-Off Panels: Aluminum face and back sheets, polyisocyanurate foam core, 1-1/2 inch thick, painted black on exterior side; provide where duct connected to louver is smaller than louver frame, sealing off louver area outside duct.
- C. Fasteners and Anchors: Galvanized steel.
- D. Flashings: Of same material as louver frame, formed to required shape, single length in one piece per location.
- E. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that prepared openings and flashings are ready to receive this work and opening dimensions are as indicated on shop drawings.
- B. Verify that field measurements are as indicated.

3.2 INSTALLATION

- A. Install louver assembly in accordance with manufacturer's instructions.
- B. Coordinate with installation of flashings by others.
- C. Install louvers level and plumb.
- D. Install flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.
- E. Secure louver frames in openings with concealed fasteners.
- F. Install perimeter sealant and backing rod in accordance with Section 07 90 05.
- G. Coordinate with installation of mechanical ductwork.

3.3 CLEANING

- A. Strip protective finish coverings.
- B. Clean surfaces and components.

END OF SECTION 08 91 00

SECTION 09 21 16 - GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
- B. Acoustic insulation.
- C. Gypsum wallboard.
- D. Joint treatment and accessories.

1.2 REFERENCE STANDARDS

- A. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
- B. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board.
- C. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
- D. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
- E. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base.
- F. ASTM C1396/C1396M - Standard Specification for Gypsum Board.
- G. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels.
- H. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels.
- I. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.

- J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- K. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- L. ASTM E413 - Classification for Rating Sound Insulation.
- M. GA-216 - Application and Finishing of Gypsum Board.
- N. GA-600 - Fire Resistance Design Manual.
- O. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems.

1.3 SUBMITTALS

- A. Product Data: Provide data on gypsum board, glass mat faced gypsum board, accessories, and joint finishing system.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing gypsum board application and finishing, with minimum 5 years of documented experience.

PART 2 PRODUCTS

2.1 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
- B. Interior Partitions, Indicated as Sound-Rated: Provide completed assemblies with the following characteristics:
 - 1. Acoustic Attenuation: STC as indicated calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- C. Fire Rated Assemblies: Provide completed assemblies as indicated on Drawings.

2.2 BOARD MATERIALS

- A. Manufacturers - Gypsum-Based Board:
 - 1. CertainTeed Corporation: www.certainteed.com/#sle.

2. Georgia-Pacific Gypsum: www.gpgypsum.com/#sle.
 3. National Gypsum Company: www.nationalgypsum.com/#sle.
 4. USG Corporation: www.usg.com/#sle.
- B. Gypsum Wallboard (KEYNOTE: 092116-B): Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Use for vertical surfaces, unless otherwise indicated.
 2. Glass mat faced gypsum panels, as defined in ASTM C1658/C1658M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
 3. Unfaced fiber-reinforced gypsum panels as defined in ASTM C1278/C1278M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
 4. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 5. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 6. Thickness: 5/8 inch unless otherwise indicated on Drawings.
 - a. Multi-Layer Assemblies: Thicknesses as indicated on drawings.
- C. Impact Resistant Wallboard (KEYNOTE: 092116-A):
1. Application: as indicated on drawings.
 2. Surface Abrasion: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
 3. Indentation: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
 4. Soft Body Impact: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
 5. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.

6. Paper-Faced Type: Gypsum wallboard, as defined in ASTM C1396/C1396M.
 7. Type: Fire-resistance-rated Type X, UL or WH listed.
 8. Thickness: 5/8 inch.
 9. Edges: Tapered.
- D. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Ceilings, unless otherwise indicated.
 2. Type: Type C at fire-rated assemblies.
 3. Thickness: 1/2 inch.
 4. Edges: Tapered.

2.3 GYPSUM BOARD ACCESSORIES

- A. Acoustic Insulation (KEYNOTE: 0921116-K): ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness as indicated.
- B. Finishing Accessories: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
1. Types: As detailed or required for finished appearance.
 2. Special Shapes: In addition to conventional corner bead and control joints, provide L-bead at exposed panel edges unless noted otherwise.
- C. Beads, Joint Accessories, and Other Trim: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
1. Corner Beads: Low profile, for 90 degree outside corners.
 2. L-Trim: Sized to fit 5/8 inch thick gypsum wallboard.
 3. Control Joints:
 - a. At Assemblies Indicated with Fire-Resistance Rating: Provide rating equal to rated assembly when joint system tested in accordance with UL 2079.

- b. Type: V-shaped PVC with tear away fins.
- D. Decorative Metal Trim (KEYNOTE: 092116-S):
- 1. Material: Extruded aluminum alloy 6063-T5 temper.
 - 2. Finish: Anodized, clear.
 - 3. Location: Where indicated on the Drawings
 - 4. Type: Profile as selected from manufacturer's standard range.
 - 5. Corner Trim:
 - a. Products:
 - 1) Tamlyn: www.xtremeias.com.
 - 2) Basis of Design: Fry Reglet: www.fryreglet.com.
 - 3) Or approved equal.
 - 6. Reveal Trim:
 - a. Products:
 - 1) Tamlyn: www.xtremeias.com/#sle.
 - 2) Basis of Design: Fry Reglet: www.fryreglet.com.
 - 3) Or approved equal.
 - 7. Molding Trim:
 - a. Products:
 - 1) Tamlyn; ____: www.xtremeias.com/#sle.
 - 2) Basis of Design: Fry Reglet: www.fryreglet.com.
 - 3) Or approved equal.
- E. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.

1. Fiberglass Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
 2. Paper Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
 3. Ready-mixed vinyl-based joint compound.
 4. Powder-type vinyl-based compound.
 5. Chemical hardening type compound.
 6. Joint Compound: Setting type, field-mixed.
- F. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.
- G. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion-resistant.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

3.2 ACOUSTIC ACCESSORIES INSTALLATION

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

3.3 BOARD INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.

- C. Double-Layer Non-Rated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.
- D. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- E. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.
- F. Exterior Soffits: Install exterior soffit board perpendicular to framing, with staggered end joints over framing members or other solid backing.
 - 1. Seal joints, cut edges, and holes with water-resistant sealant.
- G. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of nonrated double-layer assemblies, which may be installed by means of adhesive lamination.

3.4 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
 - 1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
 - 2. At exterior soffits, not more than 30 feet apart in both directions.
 - 3. Install per GA-234/GA-216, or ASTM C840.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.
- D. Decorative Trim: Install at locations shown on drawings and in accordance with manufacturer's instructions.

3.5 JOINT TREATMENT

- A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, embed and finish with setting type joint compound.

- B. Paper Faced Gypsum Board: Use paper joint tape, bedded with ready-mixed vinyl-based joint compound and finished with ready-mixed vinyl-based joint compound.
- C. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
 - 1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
 - 2. Level 3: Walls to receive textured wall finish.
 - 3. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
 - 4. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- D. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 - 1. Feather coats of joint compound so that camber is maximum 1/32 inch.
 - 2. Taping, filling, and sanding are not required at base layer of double-layer applications.

3.6 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION 09 21 16

SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Metal partition and ceiling framing.
- B. Framing accessories.

1.2 REFERENCE STANDARDS

- A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- C. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members.
- D. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
- E. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
- F. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
- G. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- H. ASTM E413 - Classification for Rating Sound Insulation.
- I. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic").

1.3 SUBMITTALS

- A. Shop Drawings:

1. Indicate prefabricated work, component details, stud layout, framed openings, anchorage to structure, acoustic details, type and location of fasteners, accessories, and items of other related work.
 2. Describe method for securing studs to tracks, splicing, and for blocking and reinforcement of framing connections.
- B. Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations.
- C. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience and approved by manufacturer.

PART 2 PRODUCTS

2.1 DESCRIPTION

- 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 E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent MR testing agency.

2.2 FRAMING MATERIALS

- A. Fire Rated Assemblies: Comply with applicable code and as indicated on drawings.
- B. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf.
1. Studs: C shaped with knurled or embossed faces.
 2. Runners: U shaped, sized to match studs.

3. Ceiling Channels: C shaped.
 4. Furring: Hat-shaped sections, minimum depth of 7/8 inch.
- C. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws, and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100.
 2. Material: ASTM A653/A653M steel sheet, SS Grade 50, with G60/Z180 hot-dipped galvanized coating.
 3. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems indicated on drawings.
- D. Deflection and Firestop Track: Intumescent strip factory-applied to track flanges expands when exposed to heat or flames to provide a perimeter joint seal.
- E. Tracks and Runners: Same material and thickness as studs, bent leg retainer notched to receive studs with provision for crimp locking to stud.
- F. Furring and Bracing Members: Of same material as studs; thickness to suit purpose; complying with applicable requirements of ASTM C754.
- G. Fasteners: ASTM C1002 self-piercing tapping screws.
- H. Sheet Metal Backing: 0.036 inch thick, galvanized.
- I. Anchorage Devices: Powder actuated.
- J. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
- K. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic.

2.3 FABRICATION

- A. Fabricate assemblies of framed sections to sizes and profiles required.
- B. Fit, reinforce, and brace framing members to suit design requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that rough-in utilities are in proper location.

3.2 INSTALLATION OF STUD FRAMING

- A. Comply with requirements of ASTM C754.
- B. Extend partition framing to structure in all locations, unless shown otherwise on drawings.
- C. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
- D. Align and secure top and bottom runners at 24 inches on center.
- E. At partitions indicated with an acoustic rating:
 - 1. Provide components and install as required to produce STC ratings as indicated, based on published tests by manufacturer conducted in accordance with ASTM E90 with STC rating calculated in accordance with ASTM E413.
- F. Place one bead of acoustic sealant between runners and substrate, studs and adjacent construction.
 - 1. Place one bead of acoustic sealant between studs and adjacent vertical surfaces.
- G. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.
- H. Install studs vertically at 12, 16 or 24 inches on center, to meet specified performance requirements.
- I. Align stud web openings horizontally.
- J. Secure studs to tracks.
- K. Stud splicing is not permissible.

- L. Fabricate corners using a minimum of three studs.
- M. Install double studs at wall openings, door and window jambs, not more than 2 inches from each side of openings.
- N. Brace stud framing system rigid.
- O. Coordinate erection of studs with requirements of all openings; install supports and attachments.
- P. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.
- Q. Blocking: Use wood blocking secured to studs. Provide blocking where indicated, and for support of toilet partitions, wall cabinets, toilet accessories, and other wall mounted accessories.
- R. Furring: Install at spacing and locations shown on drawings. Lap splices a minimum of 6 inches.

3.3 CEILING AND SOFFIT FRAMING

- A. Comply with requirements of ASTM C754.
- B. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.
- C. Install furring independent of walls, columns, and above-ceiling work.
- D. Securely anchor hangers to structural members or embed them in structural slab. Space hangers as required to limit deflection to criteria indicated. Use rigid hangers at exterior soffits.
- E. Space main carrying channels at maximum 72 inch on center, and not more than 6 inches from wall surfaces. Lap splice securely.
- F. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.
- G. Place furring channels perpendicular to carrying channels, not more than 2 inches from perimeter walls, and rigidly secure. Lap splices securely.

- H. Reinforce openings in suspension system that interrupt main carrying channels or furring channels with lateral channel bracing. Extend bracing minimum 24 inches past each opening.

3.4 TOLERANCES

- A. Maximum Variation From True Position: 1/8 inch in 10 feet.
- B. Maximum Variation From Plumb: 1/8 inch in 10 feet.

END OF SECTION 09 22 16

SECTION 09 30 00 - TILING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Tile for wall applications.
- B. Cementitious backer board as tile substrate.
- C. Tile accessories.

1.2 REFERENCE STANDARDS

- A. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium)..
- B. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar.
- C. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar.
- D. ANSI A108.1c - Specifications for Contractors Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Bed with Dry-Set or Latex-Portland Cement.
- E. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive.
- F. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar.
- G. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy.
- H. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout.
- I. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout.

- J. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework.
- K. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units.
- L. ANSI A108.12 - American National Standard for Installation of Ceramic Tile with EGP (Exterior glue plywood) Latex-Portland Cement Mortar.
- M. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone.
- N. ANSI A118.7 - American National Standard Specifications for High Performance Cement Grouts for Tile Installation.
- O. ANSI A118.15 - American National Standard Specifications for Improved Modified Dry-Set Cement Mortar.
- P. ANSI A137.1 - American National Standard Specifications for Ceramic Tile.
- Q. ASTM C373 - Standard Test Method for Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Whiteware Products, Ceramic Tiles, and Glass Tiles.
- R. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation.

1.3 SUBMITTALS

- A. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- B. Samples: Mount tile and apply grout on two plywood panels, minimum 12x 24 inches in size illustrating pattern, color variations, and grout joint size variations.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Installer's Qualification Statement:
 - 1. Submit documentation of National Tile Contractors Association (NTCA) or Tile Contractors' Association of America (TCAA) accreditation.

- E. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Tile: Quantity equal to 2 percent of total installed.

1.4 QUALITY ASSURANCE

- A. Maintain one copy of and ANSI A108/A118/A136 and TCNA (HB) on site.
- B. Installer Qualifications:
 - 1. Company specializing in performing tile installation, with minimum of five years of documented experience.

1.5 MOCK-UPS

- A. Construct tile mock-up where approved by Architect or Owner, incorporating all components specified for the location.
 - 1. Approved mock-up may remain as part of work.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 TILE

- A. Manufacturers: All products by the same manufacturer.
 - 1. Stone Source; <https://stonesource.com/>
 - 2. Dal-Tile Corporation; ____: www.daltile.com/#sle.
 - 3. Mosa; <https://www.mosa.com/en>.
- B. Porcelain Tile, Type W-2: ANSI A137.1 standard grade.
 - 1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.

2. Size: 12 by 24 inch, nominal.
3. Thickness: 9.3 mm inch.
4. Edges: Square.
5. Surface Finish: Glazed.
6. Color(s): As indicated on drawings.
7. Pattern: As indicated on drawings..
8. Products:
 - a. StoneSource: <https://stonesource.com/product/studio-elements-sandstone>
 - b. or approved equal.

2.2 TRIM AND ACCESSORIES

- A. Non-Ceramic Trim: (KEYNOTE: 093000-G) Satin natural anodized extruded aluminum, style and dimensions to suit application, for setting using tile mortar or adhesive.
 1. Applications:
 - a. Floor base to wall joints.
 2. Manufacturers:
 - a. Schluter-Systems: www.schluter.com/#sle. JOLLY

2.3 SETTING MATERIALS

- A. Improved Latex-Portland Cement Mortar Bond Coat: ANSI A118.15.
 1. Applications: Use this type of bond coat where indicated and where no other type of bond coat is indicated.
 2. Products:
 - a. ARDEX Engineered Cements; S 28: www.ardexamericas.com/#sle.

- b. Custom Building Products; Complete Contact-LFT Premium Rapid Setting Large Format Tile Mortar, with Multi-Surface Bonding
Primer: www.custombuildingproducts.com/#sle.
- c. H.B. Fuller Construction Products, Inc; TEC TotalFlex 150 Universal Mortar: www.tecspecialty.com/#sle.
- d. or approved equal.

2.4 GROUTS

- A. High Performance Polymer Modified Grout: ANSI A118.7 polymer modified cement grout.
 - 1. Applications: Use this type of grout where indicated and where no other type of grout is indicated.
 - 2. Use sanded grout for joints 1/8 inch wide and larger; use unsanded grout for joints less than 1/8 inch wide.
 - 3. Color(s): As selected by Architect from manufacturer's full line.
 - 4. Products:
 - a. ARDEX Engineered Cements; ARDEX FL: www.ardexamericas.com/#sle.
 - b. H.B. Fuller Construction Products, Inc; TEC AccuColor Plus Grout: www.tecspecialty.com/#sle.
 - c. LATICRETE International, Inc; LATICRETE PERMACOLOR Grout: www.laticrete.com/#sle.
 - d. or approved equal..

2.5 ACCESSORY MATERIALS

- A. Backer Board: Cementitious type complying with ANSI A118.9; high density, glass fiber reinforced, 7/16 inch thick; 2 inch wide coated glass fiber tape for joints and corners.
 - 1. Location: Wet walls

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.

3.2 PREPARATION

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.
- E. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

3.3 INSTALLATION - GENERAL

- A. Install tile and thresholds and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.13, manufacturer's instructions, and TCNA (HB) recommendations.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align wall joints.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- E. Form internal angles square and external angles bullnosed.
- F. Install ceramic accessories rigidly in prepared openings.
- G. Install non-ceramic trim in accordance with manufacturer's instructions.

- H. Install thresholds where indicated.
- I. Sound tile after setting. Replace hollow sounding units.
- J. Keep control and expansion joints free of mortar, grout, and adhesive.
- K. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- L. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.
- M. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.4 INSTALLATION - WALL TILE

- A. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244, using membrane at toilet rooms.

3.5 CLEANING

- A. Clean tile and grout surfaces.

3.6 PROTECTION

- A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION 09 30 00

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SECTION 09 51 00 - ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.

1.2 REFERENCE STANDARDS

- A. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
- B. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
- C. ASTM E1264 - Standard Classification for Acoustical Ceiling Products.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

1.4 SUBMITTALS

- A. Shop Drawings: Indicate grid layout and related dimensioning, junctions with other ceiling finishes, and mechanical and electrical items installed in the ceiling.
- B. Product Data: Provide data on suspension system components and acoustical units.
- C. Samples: Submit two samples 6x6 inch in size illustrating material and finish of acoustical units.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Acoustical Units: Quantity equal to 2 percent of total installed.

1.5 QUALITY ASSURANCE

- A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.6 FIELD CONDITIONS

- A. Maintain uniform temperature within range recommended by manufacturer, but not less 60 degrees F, with a maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acoustic Tiles/Panels:
 - 1. Armstrong World Industries, Inc: www.armstrongceilings.com/#sle.
 - 2. CertainTeed Corporation: www.certainteed.com/#sle.
 - 3. Rockfon: www.rockfon.com/#sle.
- B. Suspension Systems:
 - 1. Same as for acoustical units.

2.2 ACOUSTICAL UNITS

- A. Acoustical Units - General: ASTM E1264, Class A.
- B. Acoustical Panels for Seamless System, Ceiling Types: 2.01: Mineral fiber, with the following characteristics:
 - 1. Size: 48 by 72 inches.
 - 2. Thickness: 7/8 inches.
 - 3. Panel Edge: Tapered edges four sides.

4. Noise Reduction Coefficient (NRC): ASTM C 423; Panel 0.80 (UL)
5. Ceiling Attenuation Class (CAC): ASTM C 1414; Panel 46 (UL), System up to 48
6. Sabin: Cloud Applications: 0.80 Sabins/SF
7. Flame Spread: ASTM E 1264; Class A
8. Light Reflectance (LR) White Panel: ASTM E 1477; 0.87
9. Dimensional Stability: HumiGuard Plus
10. Color: White (Armstrong: #2604WH)
11. Suspension System:
 - a. Armstrong Drywall Suspension Systems all main beams and cross tees shall be commercial quality hot-dipped galvanized steel
 - 1) Main beam: manufactured main beam- 1-1/2" knurled face with ScrewStop™ reverse hem by 1-11/16 inches high. Drywall Main Beams are factory punched with cross tee routs, hanger wire holes, and SuperLock™ main beam clip for a strong secure connection and fast accurate alignment. Drywall Main Beams are Heavy-duty performance per ASTM C635
 - 2) HD8906 - 12ft HD Drywall Main Beam 1-1/2 in
 - b. Cross Tees: manufactured cross tee- 1-1/2" knurled face with ScrewStop™ reverse hem by 1-1/2 inches high with factory punched cross tee routs and hanger wire holes and XL stake on clip for a strong secure connection.
 - 1) XL8945P - 4ft Drywall Cross Tee
12. Finish:
 - a. Joint Compound:
 - b. Setting Compound: Lightweight setting-type drywall joint compound, Ultra lightweight drying-type drywall joint compound
 - 1) Joint Tape: Self-Adhesive mesh drywall joint tape (Panel to Panel)

- (a) Use Setting Type Compound for initial coats and use Drying Type Compound for final coats per the installation instructions. DO NOT use any other type of drywall compound such as All-Purpose Compound.
 - (b) Paper tape at the wall intersection
 - c. Spray Applied Finish:
 - 1) Product: #2605WH Fine Texture Finish for ACOUSTIBuilt panels.
- 13. Products:
 - a. Armstrong World Industries: ACOUSTIBuilt.
 - b. Or Approved Equal
- C. Acoustical Panels, Type 1.01: Mineral fiber with membrane-faced overlay, with the following characteristics:
 - 1. Classification: ASTM E1264 Type IV.
 - a. Pattern: smooth texture.
 - 2. Size: 24 by 24 inches.
 - 3. Thickness: 3/4 inch.
 - 4. Light Reflectance: .85 percent, determined in accordance with ASTM E1264.
 - 5. NRC Range: .85, determined in accordance with ASTM E1264.
 - 6. Ceiling Attenuation Class (CAC): 35, determined in accordance with ASTM E1264.
 - 7. Panel Edge: Tegular.
 - 8. Color: White.
 - 9. Suspension System Type A: Exposed grid. Prelude XL
 - 10. Products:
 - a. Armstrong World Industries, Inc; Calla: www.armstrongceilings.com/#sle.

- b. Armstrong World Industries, Inc; Ultima High NRC
: www.armstrongceilings.com/#sle.
 - c. CertainTeed Corporation; Symphony m High NRC
: www.certainteed.com/ceilings-and-walls/#sle.
- D. Acoustical Panels, Type 1.11: Glass fiber with membrane-faced overlay, with the following characteristics:
- 1. Classification: ASTM E1264 Type XII.
 - 2. Size: 48 by 48 inches.
 - 3. Thickness: 7/8 inch.
 - 4. NRC Range: 90, determined in accordance with ASTM E1264.
 - 5. Ceiling Attenuation Class (CAC): N/A, determined in accordance with ASTM E1264.
 - 6. Panel Edge: Vector.
 - 7. Color: White.
 - 8. Suspension System Type Prelude XL 15/16".
 - 9. Products:
 - a. Armstrong World Industries, Inc; Optima Vector
: www.armstrongceilings.com/#sle.

2.3 SUSPENSION SYSTEM(S)

- A. Manufacturer: Same as for acoustical units.
- B. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.
- C. Exposed Steel Suspension System Type A: Formed steel, commercial quality cold rolled; heavy-duty.
 - 1. Profile: Tee; 15/16 inch wide face.

2. Construction: Double web.
 3. Finish: White painted.
- D. Exposed Steel Suspension System Type B: Formed steel, commercial quality, hot dipped galvanized steel; heavy-duty.
1. Profile: Tee; 15/16 inch wide face.
 2. Construction: Double web.
 3. Steel: Hot dipped galvanized.
 4. Finish: White painted.

2.4 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Hanger Wire: 12 gauge, 0.08 inch galvanized steel wire.
- C. Perimeter Moldings (KEYNOTE: 095100-C): Same metal and finish as grid.
1. Size: As required for installation conditions and specified Seismic Design Category.
 2. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.
 3. At every outside corner bullnose in a CMU wall, provide a bullnose corner cover.
- D. Seamless Ceiling Transition Trim (KEYNOTE: 095100-D) Steel or extruded aluminum; provide attachment clips, splice plates, and preformed corner pieces for complete trim system. Height as indicated on drawings.
1. Color: White.
 2. Products:
- E. Transition Moulding: Same metal and finish as grid.
1. Color: White.

2. Products:

- a. Basis of Design: Transition Mouldings by Armstrong
- b. Or approved equal.

F. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

3.2 PREPARATION

- A. Install after major above-ceiling work is complete.
- B. Coordinate the location of hangers with other work.

3.3 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C636/C636M and manufacturer's instructions and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Locate system on room axis according to reflected ceiling plan.
- D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 - 1. Use longest practical lengths.
 - 2. Overlap and rivet corners.
- E. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.

- F. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- G. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- H. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- I. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- J. Do not eccentrically load system or induce rotation of runners.

3.4 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install units after above-ceiling work is complete.
- E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- F. Cutting Acoustical Units:
 - 1. Make field cut edges of same profile as factory edges.
 - 2. Double cut and field paint exposed reveal edges.
- G. Where round obstructions and bullnose concrete block corners occur, provide preformed closures to match perimeter molding.
- H. For seamless acoustical ceiling system, follow manufacturer's installation instructions.

3.5 INSTALLATION - SEAMLESS CEILING (CEILING TYPE 2.01)

- A. Install in accordance with manufacturer's instructions.

- B. Suspend main beam from overhead construction with hanger wires spaced 4'-0" on center along the length of the main runner. Install hanger wires plumb and straight.
 - 1. 48" cross tees shall be installed 16" on center. Extra cross tees are required at 72" every 12'. All 4 panel edges must be supported by a grid main or tee.
 - 2. Install wall moldings/perimeter trim at intersection of suspended ceiling and vertical surfaces.
 - 3. Main runners and cross tees shall be attached at perimeter conditions.
 - 4. When determining the grid layout, consider the long edges of the boards must run parallel with the mains.
- C. This system relies on a square grid system to ensure panel edges align at centers of cross tees. If the installation does not meet these squareness requirements, the panel edges may run off the grid system.
 - 1. The system must be square to within 1/8" over a 48"x48" module.
 - 2. The suspension system must be leveled to within 1/4" in 10'.
- D. Control joints are required following the standards used for gypsum board listed in ASTM C840, Section 20.
 - 1. Ceilings with perimeter relief cannot exceed 50 LF and 2500 SF between control joints
 - 2. Ceilings without perimeter relief cannot exceed 30 LF and 900 SF between control joints.
- E. Panel joints and fasteners are finished with tape and compound to create a flat surface. While the materials used to finish the panels are also used to finish drywall, the procedure has unique requirements.
- F. Joint compound coverage shall be limited to preserve the acoustical performance of the panels. Compound at panel joints should not exceed 8 inch widths. Compound applied to field fasteners shall not exceed 2 inch by 2 inch areas. All compound shall be smooth and free of tool marks and ridges. Panels are to be finished with taping knives. Production tools, including boxes, are detailed on the installation instructions.

- G. Sanding and inspections: Throughout the sanding process, inspect the surface frequently for flatness. Direct a light across the ceiling to highlight unevenness that requires attention.
- H. Fine Texture Finish shall be applied in 4-5 coat process as called out in the installation instructions. finish is applied in multiple coats, layered to achieve a uniform appearance and acoustical performance.

3.6 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION 09 51 00

SECTION 09 65 00 - RESILIENT FLOORING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Resilient base.
- B. Installation accessories.

1.2 REFERENCE STANDARDS

- A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
- B. ASTM F1861 - Standard Specification for Resilient Wall Base.
- C. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

1.3 SUBMITTALS

- A. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- B. Shop Drawings: Provide plans indicating product, color and texture, floor pattern(s), and direction(s) of material. For sheet flooring, plans should indicate seam locations.
- C. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.
- D. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of subfloor is acceptable.
- E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Wall Base: 10 linear feet of each type and color.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Maintain temperature in storage area within range recommended by manufacturer(s) but at a temperature no less than 55 degrees F and no more than 90 degrees F.
- D. Do not double stack pallets.

1.5 FIELD CONDITIONS

- A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS

2.1 RESILIENT BASE

- A. Resilient Base - Type B-2 (KEYNOTE: 096500-B): ASTM F1861, Type TS rubber, vulcanized thermoset; Style B, Cove.
 - 1. Manufacturers:
 - a. Basis of Design: Tarkett: www.commercial.tarkett.com
 - 1) Dark Brown B
 - b. Other acceptable manufacturers:
 - 1) Mannington Commercial: www.manningtoncommercial.com/#sle.
 - 2) Roppe Corporation; Contours Profiled Wall Base System: www.roppe.com/#sle.
 - 3) Or approved equal.
 - 2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
 - 3. Height: 4 inch.

4. Thickness: 0.125 inch.
 5. Finish: Satin.
 6. Color: As indicated on drawings.
- B. Resilient Base - Type B-3 (KEYNOTE: 096500-B): ASTM F1816, Type TS rubber, vulcanized thermoset; Style A; Straight.
1. Manufacturers:
 - a. Basis of Design: Tarkett: www.commercial.tarkett.com
 - 1) Dark Brown B
 - 2) or approved equal
 2. Height: 4 inch
 3. Thickness: 0.125 inch
 4. Finish: Satin.
 5. Color: As indicated on drawings.
- C. Resilient Base - Type B-4 (KEYNOTE: 096500-B): ASTM F1816, Type TS rubber, vulcanized thermoset; Style A; Straight
1. Manufacturers: Basis of Design: Tarkett: www.commercial.tarkett.com
 - a. Vapor Gray or approved equal
 2. Height: 4 inch
 3. Thickness: 0.125 inch
 4. Finish: Satin.
 5. Color: As indicated on drawings.

2.2 ACCESSORIES

- A. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.

- B. Filler for Coved Base: Plastic.
- C. Prefabricated Coved Base: Bonded Aluminum Reinforcing Backer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.
- C. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.
- C. Prohibit traffic until filler is fully cured.
- D. Clean substrate.

3.3 INSTALLATION - GENERAL

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install in accordance with manufacturer's written instructions.
- C. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.
- D. Spread only enough adhesive to permit installation of materials before initial set.
- E. Fit joints and butt seams tightly.
- F. Set flooring in place, press with heavy roller to attain full adhesion.

- G. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- H. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
- I. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.4 INSTALLATION - RESILIENT BASE

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
- B. Install base on solid backing. Bond tightly to wall and floor surfaces.

3.5 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

END OF SECTION 09 65 00

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SECTION 09 67 00 - FLUID-APPLIED FLOORING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fluid-applied flooring and base.

1.2 REFERENCE STANDARDS

- A. ANSI/ESD STM7.1 - Standard Test Method for the Protection of Electrostatic Discharge Susceptible Items - Floor Materials - Resistive Characterization of Materials.
- B. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
- C. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
- D. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

1.3 SUBMITTALS

- A. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns and colors available.
- B. Samples for Selection: Submit samples, 4 by 4 inch in size illustrating color, pattern and texture for up to 8 colors selected by Architect.
- C. Samples for Verification: Submit two samples, 12 by 12 inch in size illustrating color, pattern and texture for each floor material for each color specified.
- D. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and application rate for each coat.
- E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, procedures for stain removal, repairing surface, and suggested schedule for cleaning.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
- B. Applicator Qualifications: Company specializing in performing the work of this section.
 - 1. Minimum five years of documented experience.
 - 2. Approved by manufacturer.
- C. Supervisor Qualifications: Trained by product manufacturer , under direct full time supervision of manufacturer's own foreman.

1.5 MOCK-UPS

- A. Construct mock-up(s) of fluid applied flooring and base to serve as basis for evaluation of texture and workmanship.
 - 1. Number of Mock-Ups to be Prepared: Two.
 - 2. Use same materials and methods for use in the work.
 - 3. Use approved design samples as basis for mock-ups.
 - 4. Locate in one of the single user restrooms.
 - 5. Minimum Size: 48 inches by 48 inches.
- B. Obtain approval of mock-up by Architect before proceeding with work.
- C. Approved mock-up may remain as part of the work.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store resin materials in a dry, secure area.
- B. Store materials for three days prior to installation in area of installation to achieve temperature stability.

1.7 FIELD CONDITIONS

- A. Maintain minimum temperature in storage area of 55 degrees F.

- B. Store materials in area of installation for minimum period of 24 hours prior to installation.
- C. Maintain ambient temperature required by manufacturer 72 hours prior to, during, and 24 hours after installation of materials.

1.8 WARRANTY

- A. Submit written warranty signed by floor coating Manufacturer and installer agreeing to repair or replace floor coatings that do not meet requirements or that deteriorate within the warranty period indicated below. Warranty is to cover both materials and labor required for replacement.

- 1. Warranty Period: 5 years after date of Substantial Completion.

PART 2 PRODUCTS

2.1 FLUID-APPLIED FLOORING SYSTEMS

- A. Fluid-Applied Flooring (F1) (KEYNOTE: 096700-A): Epoxy base coat(s), with broadcast aggregate.
 - 1. Aggregate: Quartz granules. Double Broadcast.
 - 2. System Thickness: 1/8 inch, nominal, dry film thickness (DFT).
 - 3. Texture: Slip resistant.
 - 4. Cove Base (KEYNOTE 096700-B): Smooth Texture.
 - 5. Sheen: Gloss.
 - 6. Color: Match Architect's Design Sample.
 - 7. System Components: Manufacturer's standard components that are compatible with each other and as follows:
 - a. Primer.
 - b. Body Coat and Color Quartz Broadcast.
 - c. UV Resistant Seal Coat.
 - 8. Products:

- a. Crossfield Products Corp.; Dex-O-Tex Decor-Flor system with Quik-Glaze Topcoat.
- b. BASF Corp.; MasterTop 1234 with MasterTop TC 683 Series Clear Topcoat.
- c. Sika Corporation; Sikafloor Quartzite Broadcast System with Sikafloor 217 Receiver and Topcoat.
- d. Stonhard, Inc.; Stonshield SLT System with Stonkote CE4 Sealer.

2.2 ACCESSORIES

- A. Waterproofing Membrane: Type recommended or produced by manufacturer of Fluid-Applied Flooring system for type of service and floor condition indicated.
- B. Anti-Microbial Additive: Incorporate anti-microbial chemical additive to control growth of most bacteria, fungi, algae and actinomycetes.
 - 1. Provide anti-microbial additive in all flooring.
- C. Aluminum Floor Transition Strips (KEYNOTE 096700-C): As indicated on the drawings.
 - 1. Basis of Design: Schluter Systems Reno-U or approved equal.
- D. Cant Strips: Molded of flooring resin material.
- E. Subfloor Filler: Type recommended by fluid-applied flooring manufacturer.
- F. Primer: Type recommended by fluid-applied flooring manufacturer.
- G. Joint Sealant: Type recommended or produced by resinous flooring manufacturer for type of service and joint condition indicated.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive flooring.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive flooring.

- C. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of materials to subfloor surfaces.
- D. Cementitious Subfloor Surfaces: Verify that substrates are ready for fluid-applied flooring installation by testing for moisture and alkalinity (pH).
 - 1. Test as Follows:
 - a. Alkalinity (pH): ASTM F710.
 - b. Internal Relative Humidity: ASTM F2170.
 - c. Moisture Vapor Emission: ASTM F1869.
 - 2. Obtain instructions if test results are not within limits recommended by fluid-applied flooring manufacturer.
- E. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

- A. Remove subfloor ridges and bumps. Fill low spots, cracks, joints, holes, and other defects with subfloor filler.
- B. Prepare concrete control joints and expansion joints according to flooring manufacturer's instructions.
- C. Mechanically prepare (shot-blast) concrete surfaces according to flooring manufacturer's instructions.
- D. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Grind irregularities above the surface level. Prohibit traffic until filler is cured.
- E. Vacuum clean substrate.
- F. Apply primer to surfaces required by flooring manufacturer.

3.3 TERMINATIONS

- A. Chase edges to "lock" the flooring system into the concrete substrate along lines of termination.

- B. Penetration Treatment: Lap and seal flooring system onto the perimeter of the penetrating item by bridging over compatible elastomer at the interface to compensate for possible movement.
- C. Trenches: Continue flooring system into trenches to maintain monolithic protection. Treat cold joints to assure bridging of potential cracks.
- D. Treat floor drains by chasing the flooring system to lock in place at point of termination.

3.4 JOINTS AND CRACKS

- A. Treat control joint to bridge potential cracks and to maintain monolithic protection.
- B. Treat cold joints and construction joint cracks and to maintain monolithic protection on horizontal and vertical surfaces as well as horizontal and vertical interfaces.
- C. Treat vertical and horizontal contraction and expansion joints by installing backer rod and compatible sealant after coating installation is completed. Provide sealant type recommended by manufacturer for traffic conditions and chemical exposures to be encountered.

3.5 INSTALLATION - ACCESSORIES

- A. Install cant strips at base of walls where flooring is to be extended up wall as base.

3.6 INSTALLATION - FLOORING

- A. Apply in accordance with manufacturer's instructions.
- B. Apply each coat to minimum thickness required by manufacturer.
- C. Hand trowel cove base mix to wall surfaces at locations shown on Finish Schedule to form cove base height of 4 inches unless otherwise indicated. Follow manufacturer's printed instructions and details including taping, mixing, priming, troweling, sanding, and top-coating of cove base.

3.7 FIELD QUALITY CONTROL

- A. Test installed floor surface in accordance with ANSI/ESD STM7.1 .

3.8 PROTECTION

- A. Prohibit traffic on floor finish for 48 hours after installation.
- B. Barricade area to protect flooring until fully cured.
- C. Cleaning: Remove temporary covering and clean flooring just prior to final inspection. Use cleaning materials and procedures recommended by flooring manufacturer.

END OF SECTION 09 67 00

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SECTION 09 68 13 - TILE CARPETING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Carpet tile, fully adhered.
- B. Removal of existing carpet tile.

1.2 REFERENCE STANDARDS

- A. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials.
- B. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
- C. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

1.3 SUBMITTALS

- A. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- B. Shop Drawings: Indicate layout of joints.
- C. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.
- D. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience and approved by carpet tile manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Tile Carpeting:
 - 1. Shaw Contract: <https://www.shawcontract.com/en-gb/>
 - 2. Interface, Inc: www.interface.com/#sle.
 - 3. Mannington Commercial: www.manningtoncommercial.com#sle.
 - 4. Tarkett: <https://commercial.tarkett.com/>.
 - 5. J&J Flooring: <https://www.jjflooringgroup.com/>

2.2 MATERIALS

- A. Tile Carpeting, Type F-2: Tufted, manufactured in one color dye lot.
 - 1. Tile Size: 24 by 24 inch, nominal.
 - 2. Color: as indicted on the drawings.
 - 3. Pattern: Quarter Turn.
 - 4. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
 - 5. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").

2.3 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by flooring material manufacturer.

- B. Edge Strips: Embossed aluminum, color as selected by Architect.
- C. Adhesives:
 - 1. Compatible with materials being adhered; maximum VOC content of 50 g/L; CRI (GLP) certified; in lieu of labeled product, independent test report showing compliance is acceptable.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.
- B. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.

3.2 PREPARATION

- A. Remove existing carpet tile.
- B. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- C. Remove subfloor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with subfloor filler.
- D. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
- E. Vacuum clean substrate.

3.3 INSTALLATION

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install carpet tile in accordance with manufacturer's instructions.
- C. Blend carpet from different cartons to ensure minimal variation in color match.
- D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- E. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.

F. Trim carpet tile neatly at walls and around interruptions.

G. Complete installation of edge strips, concealing exposed edges.

3.4 CLEANING

A. Remove excess adhesive without damage, from floor, base, and wall surfaces.

B. Clean and vacuum carpet surfaces.

END OF SECTION 09 68 13

SECTION 09 91 23 - INTERIOR PAINTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
 - 1. Exposed surfaces include those whether or not scheduled colors are designated.
 - 2. Where suspended ceiling systems such as 'clouds' are held away from or do not touch wall surfaces, all surfaces above 'clouds' shall be painted.
 - 3. Mechanical and Electrical:
 - a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
 - b. In finished areas, paint shop-primed items.
 - c. Paint interior surfaces of air ducts and convector and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
- D. Do Not Paint or Finish the Following Items:
 - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
 - 5. Any items not permitted to be painted by the AHJ.

6. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, and lead items.
7. Marble, granite, slate, and other natural stones.
8. Floors, unless specifically indicated.
9. Ceramic and other tiles.
10. Brick, architectural concrete, cast stone, integrally colored plaster, and stucco.
11. Glass.
12. Acoustical materials, unless specifically indicated.
13. Concealed pipes, ducts, and conduits.

1.2 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency.
- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications.
- C. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating.
- D. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.
- E. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board.
- F. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association.
- G. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual.
- H. SCAQMD 1113 - South Coast Air Quality Management District Rule No.1113.
- I. SSPC-SP 1 - Solvent Cleaning.
- J. SSPC-SP 6 - Commercial Blast Cleaning.

1.3 SUBMITTALS

- A. Product Data: Provide complete list of products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").
 - 2. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
- B. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
 - 1. Where sheen is specified, submit samples in only that sheen.
- C. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, care and cleaning instructions, touch-up procedures, and repair of painted and finished surfaces.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.
 - 2. Label each container with color in addition to the manufacturer's label.

1.4 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in performing the type of work specified with minimum five years experience and approved by manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.6 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply materials when relative humidity exceeds 85 percent, at temperatures less than 5 degrees F above the dew point, or to damp or wet surfaces.
- D. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.
- B. Paints: Provide products by one of the following manufacturers:
 - 1. Base Manufacturer: Sherwin-Williams Company: www.sherwin-williams.com unless noted otherwise.
 - 2. Pittsburgh Paints: www.ppgpaints.com/#sle.
 - 3. Benjamin Moore & Company: www.benjaminmoore.com.
- C. Primer Sealers: Same manufacturer as top coats.

2.2 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.
 - 1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.

2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
 3. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
 4. Supply each paint material in quantity required to complete entire project's work from a single production run.
 5. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. Flammability: Comply with applicable code for surface burning characteristics.
- C. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
- D. Colors: As indicated on drawings.
1. Extend colors to surface edges; colors may change at any edge as directed by Architect.
 2. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling on/under which they are mounted.

2.3 PAINT SYSTEMS - INTERIOR

- A. Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board and concrete.
1. Two top coats and one coat primer.
 2. Top Coat(s): Interior Latex.
 - a. Products:
 - 1) I-OP-1: Sherwin-Williams ProMar 200 Zero VOC Interior Latex.
 - (a) Locations: All gypsum ceilings; all surfaces of storage rooms and other utility spaces.
 - (b) Top Coat Minimum Volume Solids: 42%

- 2) I-OP-2: Sherwin-Williams ProMar 200 HP Zero VOC Interior Latex.
 - (a) Locations: All other locations not included elsewhere for listed substrates.
 - (b) Top Coat Minimum Volume Solids: 40%
3. Top Coat Sheen:
 - a. Flat: MPI gloss level 1; use this sheen for ceilings and other overhead surfaces.
 - b. Eggshell: MPI gloss level 3; unless noted otherwise, use this sheen at all locations.
 - c. Semi-Gloss: MPI gloss level 5; use this sheen for wet wall locations.
4. Primer: As recommended by top coat manufacturer for specific substrate.
5. Primer for concrete masonry units: Latex Block Filler.
- B. Paint I-OP-MD Medium Duty: For surfaces subject to frequent contact by occupants, including surfaces listed below:
 1. Medium duty applications include doors, door frames, railings, handrails, guardrails, and other metal surfaces not included in other Sections.
 2. Two top coats and one coat primer.
 3. Top Coat(s): Interior Light Industrial Coating, Water Based.
 - a. Products:
 - 1) Sherwin-Williams Pro Industrial Acrylic Coating, Semi-Gloss.
 4. Top Coat Sheen:
 - a. Semi-Gloss: MPI gloss level 5; use this sheen at all locations.
 5. Primer: As recommended by top coat manufacturer for specific substrate.
 6. Top Coat Minimum Volume Solids: 33%

- C. Paint I-OP-MD-WC - Medium Duty Vertical and Overhead: Including gypsum board, plaster, concrete, concrete masonry units, uncoated steel, shop primed steel, galvanized steel, and aluminum.
 - 1. Two top coats and one coat primer.
 - 2. Top Coat(s): Interior Epoxy-Modified Latex; MPI #115 or 215.
 - a. Products:
- D. Paint I-OP-DF - Dry Fall: Metals; exposed structure and overhead-mounted services, including shop primed and non-shop primed steel deck, structural steel, metal fabrications, and insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment.
 - 1. One top coat.
 - 2. Top Coat: Latex Dry Fall, for specified sheen.
 - a. Products:
 - 1) Sherwin-Williams Pro-Industrial Waterborne Acrylic Dryfall.
 - 3. Top Coat Sheen:
 - a. Flat: MPI gloss level 1; use this sheen at all locations.
 - 4. Primer: As recommended by top coat manufacturer for specific substrate.

2.4 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
 - 1. Gypsum Wallboard: 12 percent.
 - 2. Plaster: 12 percent.
 - 3. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
 - 4. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
 - 5. Concrete Floors and Traffic Surfaces: 8 percent.

3.2 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Concrete:
 - 1. 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.
 - 2. Clean concrete according to ASTM D4258. Allow to dry.

3. Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.
- F. Masonry:
1. Remove efflorescence and chalk. Do not coat surfaces if moisture content, alkalinity of surfaces, or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
 2. Prepare surface as recommended by top coat manufacturer.
- G. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
- H. Plaster: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
- I. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.
- J. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
- K. Galvanized Surfaces:
1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
- L. Ferrous Metal:
1. Solvent clean according to SSPC-SP 1.
 2. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.
- M. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.

- N. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with clear sealer.

3.3 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Apply products in accordance with manufacturer's written instructions.
- C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- D. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- E. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.
- F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- G. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.5 PROTECTION

- A. Protect finishes until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION 09 91 23

SECTION 09 96 72 - FLUID APPLIED INSULATION COATING

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

- A. Section includes a spray-applied insulative coating including primer, insulative coating and topcoat for the following applications:
 - 1. Applied to steel penetrating the exterior envelope, from 18 inches outboard of the face of the wall to 18 inches inside the face of metal framing.

1.2 REFERENCE STANDARDS

- A. AISC (MAN) - Steel Construction Manual.
- B. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.
- C. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- D. ASTM D4060 - Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
- E. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
- F. ASTM D4585 - Standard Practice for Testing Water Resistance of Coatings Using Controlled Condensation.
- G. ASTM D5894 - Standard Practice for Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet).
- H. ASTM D870 - Standard Practice for Testing Water Resistance of Coatings Using Water Immersion.
- I. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
- J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

- K. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers; California Department of Public Health.
- L. ISO 20340 - Paints and Varnishes.
- M. SSPC-SP 6 - Commercial Blast Cleaning.
- N. UL 263 - Standard for Fire Tests of Building Construction and Materials.

1.3 SYSTEM DESCRIPTION

- A. The liquid applied thermal break acrylic material shall be applied at the required thickness specified by the manufacturer in order to mitigate thermal bridging. In no case shall the K- value of the liquid applied thermal break be more than 0.040 W/mK.

1.4 SUBMITTALS

- A. Product Data: Submit product data including manufacturers technical data indicating product performance characteristics, performance and limitation criteria.
- B. Manufacturer's Instructions: Submit manufacturer written installation instructions.
- C. Applicator Qualifications: Submit applicators current certification as a manufacturer trained applicator.

1.5 QUALITY ASSURANCE

- A. Manufacturer:
 - 1. Company specializing in manufacturing product in this section with a minimum of 2 years documented experience in manufacturing insulative technology.
 - a. Applicator: Company specializing in applying the work of this section with documented experience and trained by the manufacturer.
 - b. Fluid Applied Thermal Break Acrylic system shall be the complete system from a sole source consisting of primer, acrylic thermal break material and topcoat.
- B. Mock-up:

1. Minimum thirty days prior to application in any area, provide mock-up Samples of thermal break materials in accordance with the following requirements:
 - a. Provide minimum two square feet on representative substrate, where directed by the Engineer, for each different thickness and finish of required for the work.
 - b. Provide mock-up areas that comply with thickness, density application, finish texture, and color.
 - c. Inspect mock-up areas within one hour of application for variance due to shrinkage, temperature, and humidity.
 - d. Where shrinkage and cracking are evident, adjust mixture and method of application as necessary to meet required installation, finish, and color requirements.
 - e. Continue to provide mock-up areas until acceptable areas are produced.
 - f. Acceptable areas shall constitute standard of acceptance for method of application, thickness, finish texture, and color requirements, for fluid applied thermal break material applications.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Delivery: Deliver materials in manufacturers' original, sealed, undamaged container with identification label intact. Packaged materials shall bear the appropriate labels, seals.
- B. Storage: Materials shall be stored in strict accordance with manufacturers documented instructions.
 1. Documentation: All batch number, product identification and quantities shall be recorded on appropriate QC documents. A copy of the transport document and manufacturers conformance certificate shall be attached to the material delivery on site.

1.7 PROJECT/SITE CONDITIONS

- A. Project Environmental Requirements: Substrate and air temperature shall be in accordance with the manufacturers' requirements.

1. Protect work area from windblown dust and rain. Protect adjacent areas from over spray of material.
 2. Provide ventilation in areas to receive work of this section during application and minimum 24 hours after application.
- B. Temperature and Humidity Requirements: Maintain air temperature and relative humidity in areas where products will be applied for a time period before during and after application as recommended by manufacturer.
1. Do not apply Fluid Applied Acrylic Thermal Break when temperature of substrate and/or surrounding ambient air temperature is below 45° F. Temporary protection and heat shall be maintained at this minimum temperature for 24 hours before, during and 24 hours after material application.
 2. Steel substrate temperature shall be a minimum of 5° F (3° C) above the dew point of the surrounding air for a period of 24 hours prior, during the application of the material and 24 hour cure period.
 3. If necessary for job schedule, the General Contractor shall provide enclosures and heat to maintain proper temperatures and humidity levels in the application areas.
 4. The relative humidity of the application area shall not exceed a maximum of 85% 24 hours prior, during and 24 hours after the application of the material. The relative
 5. humidity shall not exceed 75% throughout the application and curing of the decorative top coat finish.

1.8 WARRANTY

- A. Provide manufacturer's standard 1 year warranty and applicators workmanship 1 year warranty.

PART 2 PRODUCTS

2.1 FLUID APPLIED INSULATION COATING GENERAL

- A. Materials Compatibility:

1. Provide shop and field primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
2. Provide products of same manufacturer for each coat in a coating system.

2.2 MANUFACTURERS

- A. Provide all paint and coating products from the same manufacturer to the greatest extent possible.
 1. In the event that a single manufacturer cannot provide all specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
- B. Insulation Coating:
 1. Basis of Design Manufacturer: Tnemec Company Incorporated, www.tnemec.com.
 2. Sherwin-Williams Company, www.sherwin-williams.com.
 3. Carboline Company, www.carboline.com

2.3 PRIMER

- A. Mio-Zinc Filled Aromatic Polyurethane:
 1. Basis of Design: Tnemec Series 394-0250 PerimePrime"
 - a. VOC Content: 246 grams/liter
 - b. Color: 0250 Greenish-Gray
 - c. Requirements:
 - 1) Adhesion to Steel (ASTM D4541): No less than 1,150 psi.
 - 2) Fire Testing (UL 263, ASTM E119): Any UL Classified spray-applied fire resistive materials having a maximum average density of 19.5 pcf. Including W.R. Grace Monokote MK-6/HY and Isolatek (Cafco) Blaze-Shield II (Type II).

- 3) Salt Fog Corrosion (ASTM B117): No cracking or delamination of film. No more than 1/64" rust creepage at scribe and no more than 3% rusting on plane after 10,250 hours exposure.
- 4) Slip Coefficient & Tension Creep: Meets AISC (MAN) requirements of a Class B surface with a mean slip coefficient no less than 0.57.
- 5) CDPH Compliant: Passes the California Department of Public Health (CAL (CDPH SM)) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, Version 1.1-2010.

2.4 THERMAL INSULATING COATING (KEYNOTE: 099672-A)

A. Fluid Applied Acrylic Insulation Coating

1. Basis of Design: Tnemec Series 971 Aerolon Acrylic
 - a. VOC Content: 1.9 grams/liter
 - b. Solids by Volume: 76 percent.
 - c. Colors: 1278 Insulation Yellow
 - d. Requirements:
 - 1) Abrasion (ASTM D4060): No more than 50.2 mg loss after 1,000 cycles.
 - 2) Cyclic Salt Fog/UV Exposure (ASTM D5894): No blistering, cracking, rusting or delamination of film after 5,000 hours.
 - 3) Humidity Resistance (ASTM D4585): No blistering, cracking, rusting, or delamination after 2,000 hours.
 - 4) Immersion (ASTM D870): No blistering, cracking, rusting, or delamination after six months continuous tap water immersion.
 - 5) Surface Burning Characteristics (ASTM E84): Class A
 - 6) Thermal Conductivity (ASTM C518): No greater than 0.0356 W/in-°K or 0.2468 BTU-in/ft'-hr-°F.
 - 7) NORSOK M-501 ISO 20340: Passed 25 cycles.

- 8) CDPH Compliant: Passes the California Department of Public Health (CAL (CDPH SM)) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, Version 1.1-2010.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. All surfaces to receive the specified thermal insulating coating shall follow the manufacturer's printed instructions and be clean, dry and free of oil, grease, loose mill scale, dirt, dust or other foreign substances which would impair bond of the material to the substrate.
- D. Other corrections of the surfaces to receive the Fluid Applied Insulation Coating material shall be the responsibility of the Contractor, at no additional cost to the Owner.
- E. Application of the primer and thermal insulating coating shall not commence until the contractor, applicator and inspector have examined the surfaces to receive the primer and determined the surfaces are acceptable to receive the primer and thermal insulating coating. Commencement of application means acceptance of substrate.
- F. Verify that substrate and workspace temperature and humidity conditions are in accordance with manufacturers recommendations.

3.2 SURFACE PREPARATION

- A. Prepare surfaces in accordance with manufacturer's instructions.
- B. Provide masking, drop cloths or other suitable coverings to prevent overspray onto surfaces not intended to be coated with thermal break coating.
- C. Weld spatter and defects shall be ground smooth prior to commencement of primer and fluid applied thermal break material.

- D. Primer shall not be applied to prepared substrate until the area has been adequately vented to remove all airborne dust. Prior to the application of any coating material, the blast products, dust and debris shall be removed by vacuuming.
- E. Steel Substrates: Remove rust and loose mill scale.
 - 1. Fabrication defects:
 - a. Correct steel and fabrication defects revealed by surface preparation.
 - b. Remove weld spatter and slag.
 - c. Round sharp edges and corners of welds to a smooth contour.
 - d. Smooth weld undercuts and recesses.
 - e. Grind down porous welds to pinhole-free metal.
 - f. Remove weld flux from surface.
 - 2. Ensure surfaces are dry.
 - 3. Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with SSPC-SP 6/NACE 3, unless otherwise specified.
- F. Abrasive Blast-Cleaned Surfaces: Coat abrasive blast-cleaned surfaces with primer before visible rust forms on surface. Do not leave blast-cleaned surfaces uncoated for more than 8 hours.
 - 1. Shop Primer: Prepare shop primer to receive field coat in accordance with manufacturer's instructions.

3.3 APPLICATION

- A. Apply coatings in accordance with manufacturer's instructions.
 - 1. Mix and thin coatings, including multi-component materials, in accordance with manufacturer's instructions.
 - 2. Keep containers closed when not in use to avoid contamination.
 - 3. Do not use mixed coatings beyond pot life limits.

4. Use application equipment, tools, pressure settings, and techniques in accordance with manufacturer's instructions.
- B. Uniformly apply coatings at spreading rate required to achieve specified DFT.
- C. Apply coatings to be free of film characteristics or defects that would adversely affect performance or appearance of coating systems.
- D. Apply primer at thickness recommended by manufacturer.
- E. Apply Thermal Insulative Coating as specified in Section 3.8 Coating Schedule.
- F. Apply topcoat at thickness recommended by the manufacturer.
- G. Final Dry Film Thickness (DFT) shall be measured with a dry film thickness gauge.
- H. The steel deck is not to be sprayed unless otherwise indicated.

3.4 REPAIR

- A. Materials and Surfaces Not Scheduled to Be Coated: Repair or replace damaged materials and surfaces not scheduled to be coated.
- B. Damaged Coatings: All patching and repair to material, due to damage by other trades, shall be performed under this section and paid for by the trade responsible for the damage. Patching shall be performed by applicators certified by the manufacturer and applied in accordance with the manufacturer application instructions.
- C. Coating Defects: Repair in accordance with manufacturer's instructions coatings that exhibit film characteristics or defects that would adversely affect performance or appearance of coating systems.

3.5 FIELD QUALITY CONTROL

- A. The Installer will engage an independent testing laboratory to inspect and verify the application of material in accordance with the provisions of manufacturer.
 1. Material inspection and testing shall be performed 24 hours after completion of final application coat.
 2. The results of the above tests shall be made available to all parties at the completion of each pre-designated area and approval.

3. In-place material not in compliance with the specified thickness requirements shall be corrected prior to final acceptance.
- B. The dry film thickness (DFT) of the applied material shall be measured with a non-destructive coating thickness gage after material has completely cured. All measurements shall be documented in writing and furnished to the Owner.
- C. Manufacturer's Technical Services: Coordinate with coating manufacturer's technical service department or independent sales representative for current technical data and instructions.

3.6 CLEANING AND PROTECTION

- A. Remove overspray materials from surfaces not required to be thermally protected.
- B. Protect surfaces of coating systems from damage during construction.
- C. Touch-up, or repair damaged products before Substantial Completion.

3.7 HANDLING OF THERMAL INSULATIVE COATING (REFER TO SECTION 05 1200 STRUCTURAL STEEL FRAMING)

3.8 FLUID APPLIED INSULATION COATING SCHEDULE

- A. Steel Members Penetrating Exterior Building Envelope/Inside Face of Metal Framing:
 1. Fluid Applied Thermal Break System, Mio-Zinc MCU Primer: (Refer to Section 05 1200 Structural Steel Framing)
 - a. Shop Surface Preparation: SSPC-SP 6/NACE 3
 - b. Prime Coat (Shop Applied) Series 394-0250 PerimePrime, DFT of 2.5 to 3.5 mils per coat.
 - c. Intermediate Coat (Shop Applied) - Two Coats: Series 971 Aerolon Acrylic, DFT of 40.0 to 50.0 mils per coat. Total thickness of Series 971: 80 to 100 mils.

END OF SECTION 09 96 72

SECTION 10 14 19 - DIMENSIONAL LETTER SIGNAGE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Dimensional letter signage.

1.2 PRICE AND PAYMENT PROCEDURES

- A. Allowances:

- 1. Include cash allowance for purchase and delivery but not installation.

1.3 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines.
- B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design.
- C. ICC A117.1 - Accessible and Usable Buildings and Facilities.

1.4 SUBMITTALS

- A. Product Data: Manufacturer's product literature for each type of dimensional letter sign, indicating style, font, colors, locations, and overall dimensions of each sign.
- B. Shop Drawings:
 - 1. Include dimensions, locations, elevations, materials, text and graphic layout, and attachment details.
- C. Samples: Submit one sample of each type of dimensional letter sign of size similar to that required for project, indicating sign style, font, and method of attachment.
- D. Verification Samples: Submit samples showing colors and finishes specified.
- E. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Package dimensional letter signs as required to prevent damage before installation.
- B. Store under cover and elevated above grade.

1.7 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain minimum ambient temperature during and after installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Dimensional Letter Signs:
 - 1. FASTSIGNS International, Inc: www.fastsigns.com/#sle.
 - 2. Gemini Incorporated; <https://geminimade.com/>.
 - 3. ARK Ramos

2.2 REGULATORY REQUIREMENTS

- A. Accessibility Requirements: Comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most restrictive requirements.

2.3 DIMENSIONAL LETTERS

- A. Applications: Building identification.
 - 1. Use individual metal letters.
 - 2. Mounting Location: Exterior as indicated on drawings.

B. Metal Letters (KEYNOTE: 101419-A):

1. Message: Obtain final text from Owner prior to generating Shop Drawings.
2. Material: Aluminum casting.
3. Thickness: Manufacturer's standard for letter size.
4. Letter Height: 10 inches.
5. Text and Typeface:
 - a. Character Font: Helvetica, Arial, or other sans serif font. Coordinate font with Owner.
 - b. Character Case: Upper and lower case (title case).
6. Finish: As selected by Architect from manufacturer's full range.
7. Color: As selected.
8. Mounting: Surface mounted: Concealed, noncorroding, non-damaging for substrates encountered. Mount 1/4" from substrate, with spacers..
9. Produce characters with smooth, flat faces, sharp corners, and precisely formed lines and profiles, free from pits, scale, sand holes, and other defects.
10. Location: as indicated on the drawings.

2.4 ACCESSORIES

- A. Concealed Screws: Noncorroding metal; stainless steel, galvanized steel, chrome plated, or other.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Notify Architect if conditions are not suitable for installation of signs; do not proceed until conditions are satisfactory.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install with horizontal edges level.
- C. Locate dimensional letter signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.
- D. Protect from damage until Date of Substantial Completion; repair or replace damaged items.

END OF SECTION 10 14 19

SECTION 10 14 23 - PANEL SIGNAGE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Panel signage.

1.2 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design.
- B. ICC A117.1 - Accessible and Usable Buildings and Facilities.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's product literature for each type of panel sign, indicating styles, font, foreground and background colors, locations, and overall dimensions of each sign.
- B. Shop Drawings:
 - 1. Include dimensions, locations, elevations, materials, text and graphic layout, attachment details, and schedules.
 - 2. Schedule: Provide information sufficient to completely define each panel sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
 - a. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
 - b. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
 - c. Submit for approval by Owner through Architect prior to fabrication.
- C. Samples: Submit two samples of each type of sign, of size similar to that required for project, indicating sign style, font, and method of attachment.

- D. Selection Samples: Where colors, materials, and finishes are not specified, submit two sets of color selection charts or chips.
- E. Verification Samples: Submit samples showing colors, materials, and finishes specified.
- F. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.
- B. Package room and door signs in sequential order of installation, labeled by floor or building.
- C. Store tape adhesive at normal room temperature.

1.5 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain minimum ambient temperature during and after installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Panel Signage:
 - 1. Best Sign Systems, Inc: www.bestsigns.com/#sle.
 - 2. FASTSIGNS International, Inc: www.fastsigns.com/#sle.
 - 3. Inpro Corporation: www.inprocorp.com/#sle.

2.2 REGULATORY REQUIREMENTS

- A. Accessibility Requirements: Comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most restrictive requirements.

2.3 PANEL SIGNAGE

A. Panel Signage:

1. Application: Room and door signs.
2. Description: Flat signs with engraved panel media, tactile characters.
3. Sign Size: As indicated on drawings.
4. Total Thickness: 1/8 inch.
5. Color and Font, unless otherwise indicated:
 - a. Character Font: Helvetica, Arial, or other sans serif font.
 - b. Character Case: Upper and lower case (title case).
 - c. Background Color: As scheduled.
 - d. Character Color: Contrasting color.
6. Material: Laminated colored plastic engraved through face to expose core as background color.
7. Profile: Flat panel in matching plastic frame.
8. Tactile Letters: Raised 1/32 inch minimum.
9. Braille: Grade II, ADA-compliant.
10. One-Sided Wall Mounting: Tape adhesive.

2.4 SIGNAGE APPLICATIONS

A. Room and Door Signs:

1. Office Doors: Identify with room names and numbers to be determined later, not those indicated on drawings.
2. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.

3. Rest Rooms: Identify with pictograms (of both a male, female figure, and handicap figure), the name "RESTROOM", room numbers to be determined later, and braille.

B. Emergency Evacuation Map:

1. Allow for 3.
2. Map content to be provided by Owner.
3. Use clear plastic silk-screened, in brushed aluminum frame, screw mounted.
4. Size: frame to hold an 8 1/2" x 11" insert.

2.5 ACCESSORIES

- A. Tape Adhesive: Double-sided tape, permanent adhesive.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Notify Architect if conditions are not suitable for installation of signs; do not proceed until conditions are satisfactory.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install with horizontal edges level.
- C. Locate panel signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.
- D. Protect from damage until Date of Substantial Completion; repair or replace damaged items.

END OF SECTION 10 14 23

SECTION 10 28 00 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Commercial toilet accessories.
- B. Electric hand dryers.
- C. Diaper changing stations.
- D. Utility room accessories.

1.2 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design.
- B. ASTM C1036 - Standard Specification for Flat Glass.
- C. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

1.4 SUBMITTALS

- A. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
- B. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Commercial Toilet, Shower, and Bath Accessories:
 - 1. AJW Architectural Products: www.ajw.com/#sle.

2. American Specialties, Inc: www.americanspecialties.com/#sle.
3. Bradley Corporation: www.bradleycorp.com/#sle.
4. Georgia-Pacific Professional: www.blue-connect.com/#sle.
5. Bobrick Washroom Equipment Inc.: www.bobrick.com.
6. Or approved equal.

B. Diaper Changing Stations:

1. American Specialties, Inc: www.americanspecialties.com/#sle.
2. Bradley Corporation: www.bradleycorp.com/#sle.
3. Koala Kare Products: www.koalabear.com/#sle.
4. Foundations: <https://wwwFOUNDATIONS.com>.

C. Provide products of each category type by single manufacturer.

2.2 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
1. Grind welded joints smooth.
- B. Keys: Provide 6 keys for each accessory to Owner; master key lockable accessories.
- C. Mirror Glass: Tempered safety glass, ASTM C1048; and ASTM C1036 Type I, Class 1, Quality Q1 (high-quality mirrors); silvering, protective coating, and quality requirements in compliance with ASTM C1503.

2.3 FINISHES

- A. Stainless Steel: Satin finish, unless otherwise noted.

2.4 COMMERCIAL TOILET ACCESSORIES

- A. Toilet Paper Dispenser: Double roll, surface mounted.

1. Products:
 - a. San Jamar Twin 9" JBT Dispenser.
 - b. or approved equal.
- B. Mirrors: Stainless steel framed, 1/4 inch thick tempered safety glass; ASTM C1048.
 1. Size: As indicated on drawings.
 2. Channel Frame: One piece, channel frame, stainless steel, Type 430, satin finish, 1/2 inch by 1/2 inch by 3/8 inch deep with 90 degree mitered corners.
 3. Frame: One piece, channel frame, stainless steel, Type 430, satin finish, 1/2 inch by 1/2 inch by 3/8" deep.
 - a. Provide continuous at top and bottom of mirrors.
 4. Products:
 - a. Bobrick B-165 Series, Mirror with Stainless Steel Channel Frame
 - b. or approved equal.
- C. Grab Bars: Stainless steel, smooth surface.
 1. Standard Duty Grab Bars:
 - a. Push/Pull Point Load: 250 pound-force, minimum.
 - b. Dimensions: 1-1/4 inch outside diameter, minimum 0.05 inch wall thickness, exposed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
 - c. Finish: Satin.
 - d. Length and Configuration: As indicated on drawings.
- D. Sanitary Napkin Disposal Unit: Stainless steel, surface-mounted, self-closing door, locking bottom panel with full-length stainless steel piano-type hinge, removable receptacle.
 1. Products:

- a. Bobrick B-270, ConturaSeries Surface-Mounted Sanitary Napkin Disposal.
- b. or approved equal.

2.5 ELECTRIC HAND/HAIR DRYERS

- A. Electric Hand Dryers: Traditional fan-in-case type, with downward fixed nozzle.
 - 1. Operation: Automatic, sensor-operated on and off.
 - 2. Mounting: Fully recessed.
 - 3. Cover: Stainless steel with brushed finish.
 - a. Tamper-resistant screw attachment of cover to mounting plate.
 - 4. Touch-free operation.
 - 5. Low operating noise 56dB (A) or less.
 - 6. Electric Hand Dryer Products:
 - a. TODO Clean Dry HDR 111#SS or approved equal.

2.6 DIAPER CHANGING STATIONS

- A. Diaper Changing Station: Wall-mounted folding diaper changing station for use in commercial toilet facilities, meeting or exceeding ASTM F2285.
 - 1. Material: Polyethylene.
 - 2. Mounting: Surface.
 - 3. Products:
 - a. American Specialties, Inc./9014.
 - b. Koala Kare/KB300/Color: White Granite.
 - c. Foundations/Classic/Color: Light Gray.

2.7 UTILITY ROOM ACCESSORIES

- A. Mop Holder: 0.05 inch thick stainless steel, Type 304, hat-shaped channel.

1. Holders: Three spring-loaded rubber cam holders.
2. Products:
 - a. Bobrick B-223, Stainless Steel Mop and Broom Holder.

2.8 CLOSET SHELVING

- A. Stainless steel shelving with continuous rail.
- B. Shelf: 12 inches deep and length cut to fit closet.
- C. Back wall channel, sidewall bracket, shelf trim, shelf and rod support angle bracket and closet rod.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.
- D. Verify that surfaces of mirror frames are clean, free of obstructions, and ready for installation of mirrors.
- E. Verify that field measurements are as indicated on drawings.

3.2 PREPARATION

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.
- C. Clean contact surfaces with solvent and wipe dry.

3.3 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.

- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Set mirrors plumb and level, and free of optical distortion.
- D. Set mirrors with edge clearance free of surrounding construction including countertop and backsplashes.
- E. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.
 - 1. As indicated on drawings.

3.4 PROTECTION

- A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION 10 28 00

SECTION 10 28 13 - MISCELLANEOUS SPECIALTIES

PART 1 GENERAL

1.1 DESCRIPTION OF WORK:

- A. In general, the work of this section includes the furnishing and installation of items which do not require elaborate detailing on the drawings. The schedule lists the items included in this section.
- B. Consult the drawings for the full extent of the work required under this Section.

1.2 SHOP DRAWINGS:

- A. Submit shop drawings of all items included in this section. The manufacturer shall consult the drawings, in detail, before submitting shop drawings, and shall indicate on said drawings the recommended type and spacing of anchors, and other information pertinent to the installation of his equipment at this specific location.

PART 2 PRODUCTS

2.1 PRODUCTS

- A. All products or materials as herein specified, shall be new, first quality and shall be supplied in complete accordance with the specifications.
- B. Provide color selections from manufacturers full range of colors, unless otherwise indicated.
- C. Manufacturer of model number indicated in the schedule or on the drawings are to establish a standard of quality. Similar items of other manufacturers, equal in design, function and quality will be accepted. Provide stock sizes where applicable; fabricate custom sizes for bulkhead access panels and other access panels where required to fit into the work.

1. Knox Vault (Keynote 102813-B):

- a. Provide fully recessed Knox Vault Model 3200, aluminum, single lock, with tamper switch, and aluminization, and with RMK recessed mounting kit as manufactured by the Knox Company (800-552-5669). Install at height 48" AFF in location indicated.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install all items as shown or as called for on the approved shop drawings. Consult architectural, mechanical, plumbing, electrical and telecommunication drawings for extent of ceiling, wall and bulkhead access panels.
- B. Installation shall be by experienced and qualified workmen in accordance with the approved shop drawings and the manufacturer's recommendations.
- C. Furnish, in ample time, all anchors, bolts, inserts, clips, and other items furnished under this section, but built in with the work of other trades.
- D. Shop prime all ferrous metal for supports, brackets, etc. Touch up, in the field, as required. Tint the touch up paint a different shade from the original.
- E. Provide all anchors, screw, bolts, etc. for securing work to other adjacent or adjoining work.
- F. Erect all items in proper position, securely fastened, in line, plumb and level.

END OF SECTION 10 28 13

SECTION 10 44 00 - FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Accessories.

1.2 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
- B. FM (AG) - FM Approval Guide.
- C. NFPA 10 - Standard for Portable Fire Extinguishers.
- D. UL (DIR) - Online Certifications Directory.

1.3 SUBMITTALS

- A. Product Data: Provide extinguisher operational features.
- B. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.
- C. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
- D. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Fire Extinguishers:
 - 1. Ansul, a Tyco Business; Cleanguard: www.ansul.com/#sle.
 - 2. Nystrom, Inc: www.nystrom.com/#sle.
 - 3. Pyro-Chem, a Tyco Business: www.pyrochem.com/#sle.

4. Larsen's Manufacturing Co: www.larsenmfg.com/#sle.

B. Fire Extinguisher Cabinets and Accessories:

1. Larsen's Manufacturing Co: www.larsensmfg.com/#sle.

2. Nystrom, Inc: www.nystrom.com/#sle.

3. Potter-Roemer: www.potterroemer.com/#sle.

2.2 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.

1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.

B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.

1. Class: A:B:C type.

2. Size: 10 pound.

3. Temperature range: Minus 40 degrees F to 120 degrees F.

2.3 FIRE EXTINGUISHER CABINETS

A. Cabinet Construction: Non-fire rated.

1. Formed stainless steel sheet; 0.036 inch thick base metal.

B. Cabinet Configuration: Semi-recessed type.

1. Size to accommodate accessories.

2. Trim: Flat rolled edge, with 2-1/3 inch wide face.

C. Door: 0.036 inch metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with two butt hinges.

D. Door Glazing: Acrylic plastic, clear, 1/8 inch thick, flat shape and set in resilient channel glazing gasket.

- E. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
- F. Finish of Cabinet Exterior Trim and Door: No.4 - Brushed stainless steel.
- G. Finish of Cabinet Interior: White colored enamel.

2.4 ACCESSORIES

- A. Extinguisher Brackets: Formed steel, chrome-plated.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

3.3 SCHEDULES

- A. See drawings for mounting heights.

END OF SECTION 10 44 00

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SECTION 12 48 13 - ENTRANCE FLOOR MATS AND FRAMES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Extruded aluminum entrance floor grilles.
- B. Recessed mat frames.

1.2 SUBMITTALS

- A. Product Data: Provide data indicating properties of walk-off surface, component dimensions and recessed frame characteristics.
- B. Shop Drawings: Indicate dimensions and details for recessed frame.
- C. Samples: Submit two samples, 12 by 12 inch in size illustrating pattern, color, finish, and edging.
- D. Maintenance Data: Include cleaning instructions, and stain removal procedures.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Entrance Floor Grilles and Gratings:
 - 1. Babcock-Davis: www.babcockdavis.com/#sle.
 - 2. Construction Specialties, Inc; Entrance Grids: www.c-sgroup.com/#sle.
 - 3. Nystrom, Inc; envIRONtread II Rigid Grille: www.nystrom.com/#sle.

2.2 ENTRANCE FLOOR GRILLES AND GRATINGS

- A. Entrance Floor Grilles: Recessed extruded aluminum grille assembly with nominal 1 inch wide tread strips running perpendicular to traffic flow, slots between treads, and perimeter frame forming sides of recess; grille hinged for access to recess.
 - 1. Recess Depth: 11/16 inches.
 - 2. Tread Surfaces: Alternating serrated anodized aluminum and nylon carpet.

3. Colors: To be selected by Architect from manufacturer's standard selection.
 4. Length in Direction of Traffic Flow: 72 inches.
 5. Width Perpendicular to Traffic Flow: Full width of entrance door opening.
 6. Frame: Anodized aluminum for embedding in concrete; minimal exposed trim; stud or hook concrete anchors.
- B. Mounting: Top of non-resilient members level with adjacent floor.
- C. Structural Capacity: Capable of supporting a rolling load of 500 pounds without permanent deformation or noticeable deflection.
- D. Vibration Resistant Fabrication: All members welded, riveted, or bolted; no snap or friction connections.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that floor opening for mats are ready to receive work.

3.2 PREPARATION

- A. Mats: Verify size of floor recess before fabricating mats.
- B. Vacuum clean floor recess.

3.3 INSTALLATION

- A. Install frames to achieve flush plane with finished floor surface.
- B. Install walk-off surface in floor recess flush with finish floor after cleaning of finish flooring.

3.4 TOLERANCES

- A. Maximum Gap Formed at Recessed Frame From Mat Size: 1/4 inch.

END OF SECTION 12 48 13

SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Motors.
2. Sleeves without waterstop.
3. Sleeves with waterstop.
4. Stack-sleeve fittings.
5. Sleeve-seal systems.
6. Grout.
7. Silicone sealants.
8. Escutcheons.
9. Thermometers, bimetallic actuated, lead free.
10. Thermowells, lead free.
11. Pressure gauges, dial type, lead free.
12. Gauge attachments, lead free.
13. Test plugs, lead free.
14. Test-plug kits, lead free.
15. Contractor coordination.
16. Site examination.
17. Permits

- 18. Utility connections.
- 19. Cleaning of systems.
- 20. Excavation and backfill.

1.2 DEFINITIONS

- A. “Approve” - To permit use of material, equipment or methods conditional upon compliance with contract document requirements.
- B. “Concealed” - Hidden from normal sight; includes work in crawl spaces, above ceilings, and in building shafts.
- C. “Directed” - Directed by Engineer.
- D. “Equal, equivalent” - Possessing the same performance qualities and characteristics and fulfilling the same utilitarian function.
- E. “Exposed” - Not concealed.
- F. “Furnish” - Supply and deliver to project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. “Indicated” - Indicated in Contract Documents.
- H. “Install” - Operations at project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimensions, finishing, curing, protecting, cleaning and similar operations.
- I. “Piping” - Includes pipe, fittings, valves, supports and accessories comprising a system.
- J. “Provide” - Furnish and install, complete and ready for the intended use.
- K. “Removable” - Detachable from the structure or system without physical alteration of materials or equipment and without disturbance to other construction.
- L. “Review” - Limited observation or checking to ascertain general conformance with design concept of the work and with information given in contract documents. Such action does not constitute a waiver or alteration of the contract requirements.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product, excluding motors which are included in Part 1 of the plumbing equipment Sections.
 - a. Include construction details, material descriptions, and dimensions of individual components, and finishes.
 - b. Include operating characteristics and furnished accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of gauge to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
- B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators in accordance with 2021 ASME Boiler and Pressure Vessel Code, Section IX.
- C. Contract drawings for plumbing work are diagrammatic, intended to convey scope and general arrangement.
- D. Refer questions involving document interpretation or discrepancies to Engineer for review and direction.
- E. Correct faulty work due to resolving discrepancies without proper approval.
- F. Specifications establish quality of materials, equipment, workmanship and methods of construction.

- G. Follow drawings and specifications in laying out work. Consult other applicable contract drawings and specifications, become familiar with conditions affecting work.
- H. Regulations: Comply with regulations of NFPA, state, and municipal building ordinances, and other applicable codes and regulations.
- I. Provide UL labels on electric powered equipment or certification that equipment has been tested by a testing agency approved by the local authority as equivalent in safety to UL labeled equipment.
- J. Material and Equipment Requirements
 - 1. Use products of one manufacturer where two or more items of same kind of equipment are required.
 - 2. Materials and equipment shall have a record of one-year successful field use.
 - 3. For certain items of equipment, the specification and the project design are based upon the specified manufacturer's product. Other manufacturers' names are listed. Contractor may purchase, conditional upon meeting project requirements, equipment from the listed manufacturers.
 - 4. Only the manufacturer's equipment upon which the specification and the project design has been checked for this project. Check allocated space and structure for suitability of equipment of other listed manufacturers, including parts replacement and servicing.
 - 5. Basis of Design Products: Where the Specifications or Drawings name a specific manufacturer's product accompanied by the words "Basis of Design," including make or model number or other designation, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Naming of a Basis of Design product is intended 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. The drawings indicate the general size, configuration, location, connections and/or support for equipment or systems specified with relation to the other building systems.

K. Workmanship

1. Remove and replace, at no extra cost, work not in conformance with contract requirements.
2. Coordinate work and cooperate with other trades to facilitate execution of work.

L. Coordination with Other Trades

1. Contractor shall give full cooperation and coordination with other trades and shall furnish any information necessary to permit the work of all trades to be installed satisfactorily with the least possible interference or delay.
2. The Contractor shall furnish to other trades, as required, all necessary templates, patterns, setting plans and shop details for the proper installation of the work and for the purpose of coordination adjacent work.

M. Asbestos or asbestos-containing materials shall not be utilized or allowed on this project. The Contractor shall be rigorous in assuring that all materials, equipment, systems, and components do not contain asbestos. Any deviations from this exclusion shall be remedied at the Contractor's expense without regard to prior submittal approvals.

N. Access: The Contractor shall specifically consider all materials and equipment installations and shall coordinate with the work of all trades to ensure easy and unobstructed accessibility of all systems for operations, maintenance, repairs, and replacement. Installation of all specified materials and equipment including but not limited to equipment, supports, pipe, electrical conduit and controls shall be in a manner which will allow complete unobstructed access to all panels, access doors, filter racks, control boxes, controls actuators, sensors, valves, tube bundles and all other items requiring access for operations or maintenance. All items such as controls, actuators and valves which require servicing or manual operations for system use shall be located such as to be accessible without standing on other equipment, whenever it is possible or practical. Any installation of new equipment or materials which causes problems related to access of new or existing equipment shall be disapproved by the Engineer and re-accomplished by the Contractor.

1.7 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.

B. References

1. References to standards, codes, catalogs and recommendations are latest edition in effect on date of invitation to bid.
2. Refer to applicable contract drawings and specifications pertaining to other Divisions for conditions affecting work.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Domestic water for plumbing piping intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

B. Compatibility: Provide products suitable for piping service fluids, materials, working pressures, and temperatures.

2.2 CONCRETE WORK

A. Compressive Strength: 3000-psi minimum after 28 days.

B. Reinforcing Steel: Yield strength as determined by structural design.

- C. Grout: Non-shrink, non-metallic, pre-mixed, equivalent to Nordbak Fast-set, U.S. Grout Five-star, or Polymeric.

2.3 MOTORS

A. Motor Requirements, General:

1. Content includes motors for use on alternating-current power systems of up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
2. Comply with requirements in this Section except when stricter requirements are specified in equipment schedules or Sections.
3. Comply with NEMA MG 1 unless otherwise indicated.

B. Motor Characteristics:

1. Duty: Continuous duty at an ambient temperature of 40 deg C and at altitude of 3300 ft. above sea level.
2. 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 factors.

C. Single-Phase Motors:

1. Motors larger than 1/20 hp must be one of the following, to suit starting torque and requirements of specific motor application:
 - a. Permanent-split capacitor.
 - b. Split phase.
 - c. Capacitor start, inductor run.
 - d. Capacitor start, capacitor run.
2. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

3. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
4. Motors 1/20 HP and Smaller: Shaded-pole type.
5. 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 will automatically reset when motor temperature returns to normal range.

D. Electronically Commutated Motors:

1. Microprocessor-Based Electronic Control Module: Converts 120 V or 240 V single-phase AC power to three-phase DC power to operate the brushless DC motor.
2. Three-phase power motor module with permanent magnet rotor.
3. Circuit board or digital speed controller/LED display.
4. Building Automation System Interface: Via DC voltage signal or Digital Serial Interface (DSI).

2.4 SLEEVES AND SLEEVE SEALS

A. Sleeves without Waterstop:

1. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron, with plain ends.
2. Steel Pipe Sleeves: ASTM A53, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.
3. Steel Sheet Sleeves: ASTM A653, 24 gauge minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.

B. Sleeves with Waterstop:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, LLC.

- b. CALPICO, Inc.
 - c. GPT; a division of EnPRO Industries.
 - d. Metraflex Company (The).
2. Description: Manufactured galvanized-steel, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

C. Stack-Sleeve Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. Wade; a subsidiary of McWane Inc.
 - c. Zurn Industries, LLC.
2. Description: Manufactured, galvanized cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.
- a. Underdeck Clamp: Clamping ring with setscrews.

D. Sleeve-Seal Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. Advance Products & Systems, LLC.
 - b. GPT; a division of EnPRO Industries.
 - c. Metraflex Company (The).
 - d. Proco Products, Inc.
2. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

- a. Hydrostatic Seal: 20 psig minimum.
- b. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- c. Pressure Plates: Carbon steel or Composite plastic.
- d. Connecting Bolts and Nuts: Carbon steel, with zinc coating, ASTM B633 of length required to secure pressure plates to sealing elements.

E. Grout:

- 1. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
- 2. Standard: ASTM C1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- 3. Design Mix: 5000 psi, 28-day compressive strength.
- 4. Packaging: Premixed and factory packaged.

F. Silicone Sealants:

- 1. Silicone Sealant, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) GE Construction Sealants; Momentive Performance Materials Inc.
 - 2) Sherwin-Williams Company (The).
 - 3) The Dow Chemical Company.
 - 4) Tremco Incorporated.
 - b. Standard: ASTM C920, Type S, Grade NS, Class 25, Use NT.

2. Silicone Foam Sealant: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
 - a. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1) Smooth-On.

2.5 ESCUTCHEONS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. BrassCraft Manufacturing Co.; a Masco company.
2. Dearborn Brass.
3. Jones Stephens Corp.
4. Keeney Manufacturing Company (The).
5. Mid-America Fittings, LLC; A Midland Industries Company.
6. ProFlo; a Ferguson Enterprises, Inc. brand.

B. Escutcheon Types:

1. One-Piece, Steel Type: With polished, chrome-plated or polished brass finish and setscrew fastener.
2. One-Piece, Stainless Steel Type: With polished stainless steel finish.
3. One-Piece, Cast-Brass Type: With polished, chrome-plated or polished brass finish and setscrew fastener.
4. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel or brass with polished, chrome-plated finish and spring-clip fasteners.
5. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.

6. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed and exposed-rivet hinge; and spring-clip fasteners.

C. Floor Plates:

1. Split Floor Plates: Cast brass with concealed hinge.

2.6 METERS AND GAUGES FOR PLUMBING PIPING

A. Thermometers, Bimetallic Actuated, Lead Free:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ashcroft Inc.
 - b. Marsh Bellofram.
 - c. Tel-Tru Manufacturing Company.
 - d. Terrice, H. O. Co.
 - e. WATTS; A Watts Water Technologies Company.
 - f. Weiss Instruments, Inc.
 - g. Weksler Glass Thermometer Corp.
 - h. Winters Instruments - U.S.
2. Source Limitations: Provide lead-free bimetallic-actuated thermometers from a single manufacturer.
3. Standard: ASME B40.200.
4. Case: Liquid-filled and sealed type(s); stainless steel with 5-inch nominal diameter.
5. Dial: Nonreflective aluminum with permanent scale markings and scales in deg F and deg C.

6. Connector Type(s): Union joint, adjustable angle and rigid, bottom; with ASME B1.1 or ASME B1.20.1 screw threads to fit thermowell.
7. Stem: 0.25 or 0.375 inch diameter; stainless steel.
8. Window: Safety glass or acrylic plastic.
9. Ring: Stainless steel.
10. Element: Bimetal coil.
11. Pointer: Dark-colored metal.
12. Accuracy: Plus or minus 1 percent of span.

B. Thermowells, Lead Free:

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: Lead-free copper.
4. Material for Use with Steel Piping: Type 304 stainless steel.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: 1/2, 3/4, or 1 inch, or as required to match threaded opening in pipe.
7. Internal Threads: Size and thread type as required to match thermometer mounting threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length to extend to center of pipe.
10. Lagging Extension: Include on thermowells for insulated piping and tubing. Extension is to be of sufficient length to extend beyond finished insulation surface.

11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
12. Heat-Transfer Medium: Mixture of graphite and glycerin.

C. Pressure Gauges, Dial Type, Lead Free - Direct Mounted, Metal Case:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ashcroft Inc.
 - b. Marsh Bellofram.
 - c. Tel-Tru Manufacturing Company.
 - d. Terice, H. O. Co.
 - e. WATTS; A Watts Water Technologies Company.
 - f. Weiss Instruments, Inc.
 - g. Weksler Glass Thermometer Corp.
 - h. Winters Instruments - U.S.
2. Source Limitations: Provide dial-type, lead-free, direct-mounted, metal-case pressure gauges from single manufacturer.
3. Standard: ASME B40.100.
4. Case: Liquid-filled and sealed type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
5. Pressure-Element Assembly: Lead-free Bourdon tube.
6. Pressure Connection: Lead-free brass, with 1/4 or 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
7. Movement: Mechanical, with link to pressure element and connection to pointer.

8. Dial: Nonreflective aluminum with permanent scale markings graduated in psi and kPa.
9. Pointer: Dark-colored metal.
10. Window: Safety glass or plastic.
11. Ring: Stainless steel.
12. Accuracy: Grade A, plus or minus 1 percent of middle half of span.

D. Gauge Attachments, Lead Free:

1. Snubbers: ASME B40.100, lead-free brass; with 1/4 or 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
2. Valves: Lead-free brass or stainless steel needle, with 1/4 or 1/2, ASME B1.20.1 pipe threads.

E. Test Plugs, Lead Free:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Peterson Equipment Co., Inc.
 - b. Trerice, H. O. Co.
 - c. WATTS; A Watts Water Technologies Company.
2. Source Limitations: Provide lead-free test plugs from single manufacturer.
3. Description: Test-station fitting made for insertion into piping tee fitting.
4. Body: Lead-free brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
5. Thread Size: 1/4 or 1/2, ASME B1.20.1 pipe thread.
6. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

7. Core Inserts: EPDM self-sealing rubber.

F. Test-Plug Kits, Lead Free:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Peterson Equipment Co., Inc.
2. Source Limitations: Provide lead-free test-plug kits from a single manufacturer.
3. Furnish one test-plug kit(s) containing one thermometer(s), one pressure gauge and adapter, and carrying case. Thermometer sensing elements, pressure gauge, and adapter probes are to be of diameter to fit test plugs and of length to project into piping.
4. High-Range Thermometer, Lead Free: Small, bimetallic insertion type with 1- to 2-inch diameter dial and tapered-end sensing element. Dial range is to be at least 0 to 220 deg F.
5. Pressure Gauge, Lead Free: Small, lead-free Bourdon-tube insertion type with 2- to 3-inch diameter dial and probe. Dial range is to be at least 0 to 200 psig.
6. Carrying Case: Metal or plastic, with formed instrument padding.

2.7 WARNING TAPE

- A. 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 milst 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. Blue: Water systems.
 3. Green: Sewer systems.

PART 3 EXECUTION

3.1 INSTALLATION OF CONCRETE WORK

- A. Location: Equipment foundation pads, equipment housekeeping pads, and where indicated under plumbing work.
- B. Perform work in conformance to American Concrete Institute Standard ACI 301, Specifications for Structural Concrete for Buildings.
- C. Bond new work to existing concrete, by approved adhesive or by roughing existing surface to expose aggregate uniformly, then cleaning surface. Key new pads, piers, curbs, and pedestals to concrete floors using expansion bolts.
- D. Bevel exposed vertical and horizontal edges 3/4-inch.
- E. Install grout according to manufacturer's recommendations.
- F. Testing: Test concrete using a qualified testing agency.
- G. Submit name and qualifications of testing agency for review by the Engineer.

3.2 INSTALLATION OF SLEEVES - GENERAL

- 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.
 - 2. Seal annular space between core-drilled hole and piping or piping insulation; use joint sealants that joint sealant manufacturer's literature indicates is appropriate for size, depth, and location of joint.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 2. 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.
 3. Using grout, seal the space outside of sleeves in floors/slabs/walls without sleeve-seal system. Select to maintain fire resistance of floor/slab/wall.
 4. Seal annular space between sleeve and piping or piping insulation; use joint sealants that joint sealant manufacturer's literature indicates is appropriate for size, depth, and location of joint.
- 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 that joint sealant manufacturer's literature indicates is appropriate for size, depth, and location of joint.

3.3 INSTALLATION OF SLEEVES WITH WATERSTOP

- A. Install sleeve with waterstop as new walls and slabs are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange centered across width of concrete slab or wall.
- C. Secure nailing flanges to wooden concrete forms.
- D. Using grout, seal space around outside of sleeves. Select to maintain fire resistance of floor/slab/wall.

3.4 INSTALLATION OF STACK-SLEEVE FITTINGS

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using silicone sealant, seal space between top hub of stack-sleeve fitting and pipe.

3.5 INSTALLATION OF SLEEVE-SEAL SYSTEMS

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building, and passing through exterior walls.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. 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.

3.6 INSTALLATION OF ESCUTCHEONS

- 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 insulated piping and with OD that completely covers opening.

3.7 INSTALLATION OF METERS AND GAUGES

- A. Install thermometer with thermowell at each required thermometer location.
- B. Install thermowells in vertical position in piping tees.
- C. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

- D. Install thermowells with extension on insulated piping.
- E. Fill thermowells with heat-transfer medium.
- F. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- G. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks.
- H. Install direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at most readable position.
- I. Install remote-mounted pressure gauges on panel.
- J. Install valve and snubber in piping for each pressure gauge for fluids.
- K. Install test plugs in piping tees.
- L. Install thermometers in the following locations:
 - 1. Inlet and outlet of each water heater.
 - 2. Outlet side of hot-water-balancing valve.
 - 3. Each main hot-water-recirculating line return pipe.
- M. Install pressure gauges 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.

3.12 INSTALLATION OF EQUIPMENT PADS

A. Concrete Equipment Pads

1. Provide concrete pads not less than 4 inches high and projecting not less than 3 inches on all sides beyond equipment for floor mounted equipment.
2. Place anchor bolts in steel pipe sleeves, with a plate at the bottom end of sleeve to hold bolts.
3. Grout between base plate and foundation.

3.8 CONNECTIONS

- A. Install meters and gauges adjacent to machines and equipment to allow space for service and maintenance of meters, gauges, machines, and equipment.

3.9 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gauges to proper angle for best visibility.

3.10 FIELD QUALITY CONTROL

A. Sleeves and Sleeve Seals:

1. Perform the following tests and inspections:
 - a. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
 - b. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
2. Prepare test and inspection reports.

B. Escutcheons:

1. Using new materials, replace broken and damaged escutcheons and floor plates.

3.11 SLEEVES APPLICATION

- A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above and below Grade:
 - a. Sleeves with waterstops.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
2. Concrete Slabs-on-Grade:
 - a. Sleeves with waterstops.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
3. Concrete Slabs above Grade:
 - a. Sleeves with waterstops or stack-sleeve fittings.
4. Interior Wall and Partitions:
 - a. Sleeves without waterstops.

3.12 ESCUTCHEONS APPLICATION

A. Escutcheons for New Piping and Relocated Existing Piping:

1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
2. Chrome-Plated Piping: One piece, steel, cast brass or split-casting brass with polished, chrome-plated finish.
3. Insulated Piping:
 - a. One piece, steel with polished, chrome-plated or polished brass to match adjacent finish.
4. Bare Piping at Wall and Floor Penetrations in Finished Spaces:
 - a. One piece, steel with polished, chrome-plated or polished brass to match adjacent finish.

5. Bare Piping at Ceiling Penetrations in Finished Spaces:
 - a. One piece, steel with polished, chrome-plated or polished brass to match adjacent finish.
6. Bare Piping in Unfinished Service Spaces:
 - a. One piece, steel with polished, chrome-plated finish.
7. Bare Piping in Equipment Rooms:
 - a. One piece, steel with polished, chrome-plated finish.

B. Install floor plates for piping penetrations of equipment-room floors.

C. 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 and Relocated Existing Piping: One piece, floor plate.

3.13 THERMOMETER, LEAD FREE, APPLICATION

A. Thermometers at inlet and outlet of each domestic water heater are to be the following:

1. Liquid-filled, bimetallic-actuated type.

B. Thermometer stems are to be of length to match thermowell insertion length.

C. Provide Test plug with EPDM self-sealing rubber inserts where indicated on drawings.

3.14 THERMOMETER, LEAD FREE, SCALE-RANGE APPLICATION

A. Scale Range for Domestic Cold-Water Piping:

1. 0 to 100 deg F and minus 20 to plus 50 deg C.

B. Scale Range for Domestic Hot-Water Piping:

1. 0 to 250 deg F and 0 to 150 deg C.

C. Insert additional paragraphs for thermometer scale ranges and applications.

3.15 PRESSURE-GAUGE APPLICATION

- A. Pressure gauges at discharge of each water service into building are to be the following:
 - 1. Sealed, Dial Type, Lead Free - Direct Mounted, Metal Case.
- B. Pressure gauges at inlet and outlet of each water pressure-reducing valve are to be the following:
 - 1. Sealed, Dial Type, Lead Free - Direct Mounted, Metal Case.
- C. Pressure gauges at suction and discharge of each domestic water pump are to be the following:
 - 1. Sealed, Dial Type, Lead Free - Direct Mounted, Metal Case.
- D. Provide Test plug with EPDM self-sealing rubber inserts where indicated on drawings.

3.16 PRESSURE-GAUGE SCALE-RANGE APPLICATION

- A. Scale Range for Water Service Piping:
 - 1. 0 to 100 psi and 0 to 600 kPa.
- B. Scale Range for Domestic Water Piping:
 - 1. 0 to 100 psi and 0 to 600 kPa.

3.17 COORDINATION DRAWINGS

- A. Submit, prior to installation of plumbing systems, composite working drawings prepared in coordination with other trades at a scale not less than 1/2-inch = 1-foot (1:20), clearly showing how work is to be installed in relation to the work of all trades. Contractor shall assist in working out congested space conditions to make a satisfactory adjustment. Drawings shall show the work of all trades (ductwork, conduit, piping, plumbing, lights, equipment, sprinklers, electrical work, etc.) exposed and concealed, including existing mechanical, plumbing, fire protection, and electrical services, coordinated with each other and with the structure. Drawings shall be submitted and bear the Engineer review stamp before any materials are ordered or fabricated.

- B. Work installed before coordinating with other trades or as to cause any interference with work of other trades shall be changed by the Contractor to correct the conditions at their expense.
- C. Drawings shall show existing services where clearances for access are to be maintained.
- D. Relocate existing work or modify location of new work as required to maintain required access and code clearances.

3.18 SITE EXAMINATION

- A. Failure to visit site and become familiar with local conditions prior to bidding will not relieve the Contractor of their responsibility for complying with the Contract Documents.

3.19 PERMITS

- A. Obtain and pay for required permits.

3.20 UTILITY CONNECTIONS

- A. Pay connection charges for water and sewers.

3.21 PROTECTION

- A. Protect plumbing and associated electrical material and equipment from the elements or other injury as soon as delivered on premises. Protect plumbing fixtures as soon as they are set. Cover water closets and post notices prohibiting their use.
 - 1. Accept in original packaging.
 - 2. Store in clean, dry space.
 - 3. Protect from dirt, water, construction debris, and traffic.
 - 4. Handle in accordance with manufacturer's written instructions.
- B. Cap or plug openings in equipment, piping, and conduit systems, to exclude dirt and other foreign material. Do not use rags, wool, cotton, paper, waste or similar materials for plugging.

3.22 CLEANING OF SYSTEMS

- A. Thoroughly clean systems after satisfactory completion of pressure tests and before permanently connecting fixtures, equipment, traps, strainers, and other accessory items. Blow out and flush piping until interior is free of foreign matter.
- B. Flush piping in recirculating water systems to remove cutting oil, excess pipe joint compound, and other foreign materials. Provide necessary temporary pumping equipment to thoroughly clean the water piping. Do not use system pumps until after cleaning and flushing has been accomplished to the satisfaction of the Engineer. Employ chemical cleaners, including a non-foaming detergent, not harmful to system components. Discharge flushing solution to sanitary piping system and not to floor drains connected to storm water systems. After cleaning operation, final flushing and refilling, the residual alkalinity shall not exceed 300 parts per million. Work shall be performed or supervised by a qualified water treatment service company with personnel skilled in the safe and proper use of chemicals and in testing procedures. Submit a certificate of completion to Engineer stating name of service company used.
- C. Leave strainers and dirt pockets in clean condition.
- D. Pay for labor and materials required to locate and remove obstructions from systems clogged with construction refuse after acceptance. Replace and repair work disturbed during removal of obstructions.
- E. Thoroughly clean plumbing fixtures using non-scratching cleaners. Polish chromium plated work.
- F. Leave systems clean, and in complete running order.
- G. Disinfect potable water systems as prescribed by local code. Take precautions to avoid use of fixtures during disinfecting period.

3.23 EXCAVATION AND BACKFILL

- A. Excavate and backfill as required to install underground plumbing work.
- B. establish required lines and grade.
- C. Excavate to sufficient depth to give 30-inch minimum cover, unless otherwise indicated.

D. Keep excavation drained and pumped out.

E. Remove excavated materials not required or suitable for backfill.

F. Protection

1. Protect existing utilities and underground work by shoring and bracing.
2. Provide guardrail, lamps, flags, and other safeguards at temporary walk and road crossings.
3. Provide shoring, sheet piling and bracing for protection of work and safety of personnel. Timber sheeting below top of pipe shall not be removed.
4. Protect trees, structures, and other property from injury during work.
5. Prevent debris and other materials from entering piping and drains.

G. Trenching

1. Excavate to depth and width required for proper installation of item to be buried with a minimum clearance of 8 inches and a maximum of 12 inches on each side of the pipe and to the top of the pipe with a minimum overdepth of 4 inches. If cinders are encountered at bottom of trench, increase overdepth to 10 inches.
2. Sides shall be vertical unless otherwise required by governing safety regulations.
3. Provide manholes and similar structures with a minimum of 2-inch and a maximum of 24-inch clearance on each side.

H. Backfill

1. Use only backfill material free of organic matter, cinders, frozen earth, clay, and rocks exceeding 6 inches in any dimension.
2. Provide bed of firmly compacted sand, gravel, or crushed stone of proper grade to form a uniform support. Hollow out for bells. Backfill excessive overdepth with firmly compacted sand or gravel.
3. Provide a structurally suitable reinforced concrete beam supported by the structure and undisturbed earth to support piping where a properly compacted bed

is difficult to obtain, because of fill conditions, such as may occur adjacent to building walls.

4. As items to be buried are laid, backfill with layer of sand, crushed stone, or gravel bedding material to centerline of pipe or 6 inches deep, whichever is less, and tamp.
5. After tests and inspections are complete, backfill with fine earth or sand in 6-inch layers until buried item has 1-foot of cover. Carefully tamp each layer. Compact to at least 95 percent of the maximum dry density as determined by ASTM D 1557.
6. Deposit remainder of backfill material in 8-inch layers and tamp each layer. Compact to at least 95 percent of the maximum dry density as determined by ASTM D 1557.
7. Backfill with sand, graded crushed stone, or washed gravel, inside building under or within 3 feet of equipment and under roadways. Compact to at least 95 percent of the maximum dry density as determined by ASTM D 1557.

I. Restoring

1. Restore existing pavement, curbs, sidewalks, fences, sod, shrubs, and other appurtenances removed or damaged in connection with work to original condition.
2. Replace sod with sod and replace trees, which are damaged, with trees of similar type and size.

- J. Warning Tape: Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

END OF SECTION 22 05 00

SECTION 22 05 23 – GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ball valves.
2. Butterfly valves.
3. Check valves.
4. Gate valves.

1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene-diene terpolymer.
- C. NBR: Nitrile butadiene rubber (also known as Buna-N).
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising Stem

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.
 - a. Include material descriptions and dimensions of individual components.
 - b. Include operating characteristics and furnished accessories.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.

2. Protect threads, flange faces, solder ends, and weld ends.
 3. Set ball valves open to minimize exposure of functional surfaces.
 4. Set butterfly valves closed or slightly open.
 5. Block check valves in either closed or open position.
 6. Set gate valves closed to prevent rattling.
- 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 operating handles, handwheels, stems or other components as lifting or rigging points unless specifically indicated for this purpose in manufacturer's instructions.

PART 2 PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of valve from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Standards:

1. Domestic-water piping valves intended to convey or dispense water for human consumption must comply with the U.S. Safe Drinking Water Act (SDWA), requirements of authorities having jurisdiction, and NSF 61/NSF 372; or to be certified in compliance with NSF 61/NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded-end valves.
2. ASME B16.1 for flanges on iron valves.

3. ASME B16.5 for flanges on steel valves.
 4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 5. ASME B16.18 for cast-copper solder-joint connections.
 6. ASME B16.22 for wrought-copper solder-joint connections.
 7. ASME B16.34 for flanged- and threaded-end connections.
 8. ASME B31.9 for building services piping valves.
- C. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- D. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- E. Valve Sizes: Same as upstream piping unless otherwise indicated.
- F. Valve Bypass and Drain Connections: MSS SP-45.
- G. Valve Actuator Type:
1. Gear Actuator: For quarter-turn valves 4 inches and larger.
 2. Hand Lever: For quarter-turn valves smaller than 4 inches. Butterfly valves 6-inches and smaller.
- H. Valves in Insulated Piping:
1. Ball Valves:
 - a. Provide 2-inch extended neck stems.
 - b. Extended operating handles with nonthermal-conductive covering material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
 - c. Memory stops that are fully adjustable after insulation is applied.
 2. Gate Valves:
 - a. With 2-inch stem extensions.

3. Butterfly Valves:
 - a. Provide 2-inch extended neck stems.

2.3 BALL VALVES, LEAD FREE

A. Ball Valves, Lead Free, Threaded or Soldered Ends - Brass, Two Piece with Full Port and Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. Bray Commercial.
 - c. Jenkins Valves; a Crane Co. brand.
2. Standard: MSS SP-110; MSS SP-145.
3. CWP Rating: 600 psig.
4. Body Design: Two piece.
5. Body Material: Forged brass.
6. Ends: Threaded or soldered. See Part 3 ball valve schedule articles.
7. Seats: PTFE.
8. Stem: Brass.
9. Ball: Chrome-plated brass.
10. Port: Full.

2.4 BALL VALVES, GENERAL PURPOSE

A. Ball Valves, Threaded or Soldered Ends - Brass, Two Piece with Full Port and Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.

- b. Bray Commercial.
- c. Jenkins Valves; a Crane Co. brand.
- 2. Standard: MSS SP-110; MSS SP-145.
- 3. SWP Rating: 150 psig.
- 4. CWP Rating: 600 psig.
- 5. Body Design: Two piece.
- 6. Body Material: Forged brass.
- 7. Ends: Threaded or soldered. See Part 3 ball valve schedule articles.
- 8. Seats: PTFE.
- 9. Stem: Brass.
- 10. Ball: Chrome-plated brass.
- 11. Port: Full.

B. Ball Valves, Flanged Ends - Iron, Class 125:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. WATTS; A Watts Water Technologies Company.
 - c. Zurn Industries, LLC.
- 2. Standard: MSS SP-72.
- 3. CWP Rating: 200 psig.
- 4. Body Design: Split body.
- 5. Body Material: ASTM A126, gray iron.
- 6. Ends: Flanged.

7. Seats: PTFE.
8. Stem: Stainless steel.
9. Ball: Stainless steel.
10. Port: Full.

2.5 BUTTERFLY VALVES, LEAD FREE

A. Butterfly Valves, Lead Free, Single Flange (Lug Type) - Iron, with Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. Bray Commercial.
 - c. Center Line; a Crane Co. brand.
 - d. DeZURIK.
 - e. Hammond Valve.
 - f. Jenkins Valves; a Crane Co. brand.
 - g. Kennedy Valve Company; a division of McWane, Inc.
 - h. Milwaukee Valve Company.
 - i. NIBCO INC.
 - j. Stockham; a Crane Co. brand.
 - k. WATTS; A Watts Water Technologies Company.
 - l. Zurn Industries, LLC.
2. Standard: MSS SP-67, Type I.
3. CWP Rating: 200 psig.

4. Body Design: Single flange (lug type), suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
5. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
6. Seat: EPDM or NBR. See Part 3 butterfly valve schedule articles.
7. Stem: One- or two-piece stainless steel.
8. Disc: Aluminum bronze.

2.6 BUTTERFLY VALVES, GENERAL PURPOSE

A. Butterfly Valves, Single Flange (Lug Type) - Iron, with Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. Bray Commercial.
 - c. Center Line; a Crane Co. brand.
 - d. DeZURIK.
 - e. Hammond Valve.
 - f. Jenkins Valves; a Crane Co. brand.
 - g. Kennedy Valve Company; a division of McWane, Inc.
 - h. Milwaukee Valve Company.
 - i. NIBCO INC.
 - j. Stockham; a Crane Co. brand.
 - k. WATTS; A Watts Water Technologies Company.
 - l. Zurn Industries, LLC.
2. Standard: MSS SP-67, Type I.
3. CWP Rating: 200 psig.

4. Body Design: Single flange (lug type), suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
5. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
6. Seat: NBR.
7. Stem: One- or two-piece stainless steel.
8. Disc: Aluminum bronze.

2.7 CHECK VALVES, LEAD FREE

A. Check Valves, Lead Free, Swing Type, Threaded or Soldered Ends - Bronze, with Bronze Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. Crane Fluid Systems; Crane Co.
 - c. Jenkins Valves; a Crane Co. brand.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Stockham; a Crane Co. brand.
 - g. Victaulic Company.
2. Standard: MSS SP-80, Type 3.
3. CWP Rating: 200 psig.
4. Body Design: Horizontal flow.
5. Body Material: ASTM B62, bronze.
6. Ends: Threaded or soldered. See Part 3 check valve schedule articles.
7. Disc: Bronze.

B. Check Valves, Lead Free, Swing Type, Threaded or Soldered Ends - Bronze, with Bronze Disc, Class 150:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. Crane Fluid Systems; Crane Co.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Stockham; a Crane Co. brand.
2. Standard: MSS SP-80, Type 3.
3. CWP Rating: 300 psig.
4. Body Design: Horizontal flow.
5. Body Material: ASTM B62, bronze.
6. Ends: Threaded or soldered. See Part 3 check valve schedule articles.
7. Disc: Bronze.

C. Check Valves, Lead Free, Swing Type, Flanged or Threaded Ends - Iron, with Metal Seats, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. Bray Commercial.
 - c. Crane Fluid Systems; Crane Co.
 - d. Jenkins Valves; a Crane Co. brand.
 - e. Milwaukee Valve Company.
 - f. Victaulic Company.

2. Standard: MSS SP-71, Type I.
3. CWP Rating: 200 psig.
4. Body Design: Clear or full waterway.
5. Body Material: ASTM A126, gray iron with bolted bonnet.
6. Ends: Flanged or threaded. See Part 3 check valve schedule articles.
7. Trim: Bronze.
8. Gasket: Asbestos free.

2.8 CHECK VALVES, GENERAL PURPOSE

A. Check Valves, Swing Type, Threaded or Soldered Ends - Bronze, with Bronze Disc, Class 150:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. Crane Fluid Systems; Crane Co.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Stockham; a Crane Co. brand.
2. Standard: MSS SP-80, Type 3.
3. CWP Rating: 300 psig.
4. Body Design: Horizontal flow.
5. Body Material: ASTM B62, bronze.
6. Ends: Threaded or soldered. See Part 3 check valve schedule articles.
7. Disc: Bronze.

B. Check Valves, Swing Type, Flanged Ends - Iron, with Metal Seats, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. Bray Commercial.
 - c. Crane Fluid Systems; Crane Co.
 - d. Jenkins Valves; a Crane Co. brand.
 - e. Milwaukee Valve Company.
 - f. Victaulic Company.
2. Standard: MSS SP-71, Type I.
3. CWP Rating, 2-1/2 to 12 inch: 200 psig.
4. CWP Rating, 14 to 24 inch: 150 psig.
5. Body Design: Clear or full waterway.
6. Body Material: ASTM A126, gray iron with bolted bonnet.
7. Ends: Flanged.
8. Trim: Bronze.
9. Gasket: Asbestos free.

2.9 GATE VALVES, LEAD FREE

A. Gate Valves, Lead Free, Threaded or Soldered Ends - Bronze, NRS, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. Crane Fluid Systems; Crane Co.
 - c. Milwaukee Valve Company.
 - d. Stockham; a Crane Co. brand.

2. Description:

- a. Standard: MSS SP-80, Type 1.
- b. CWP Rating: 200 psig.
- c. Body Material: Bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded or solder joint. See Part 3 gate valve schedule articles.
- e. Stem: Bronze.
- f. Disc: Solid wedge; bronze.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron, bronze, or aluminum.

B. Gate Valves, Lead Free, Flanged Ends - Iron, NRS, Class 125:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. Crane Fluid Systems; Crane Co.
 - c. Kennedy Valve Company; a division of McWane, Inc.
- 2. Standard: MSS SP-70, Type I.
- 3. CWP Rating: 200 psig.
- 4. Body Material: Gray iron with bolted bonnet.
- 5. Ends: Flanged.
- 6. Trim: Bronze.
- 7. Disc: Solid wedge.
- 8. Packing and Gasket: Asbestos free.

2.10 GATE VALVES, GENERAL PURPOSE

A. Gate Valves, Threaded or Soldered Ends - Bronze, NRS, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. Crane Fluid Systems; Crane Co.
 - c. Milwaukee Valve Company.
 - d. Stockham; a Crane Co. brand.
2. Standard: MSS SP-80, Type 1.
3. CWP Rating: 200 psig.
4. Body Material: Bronze with integral seat and screw-in bonnet.
5. Ends: Threaded or solder joint. See Part 3 gate valve schedule articles.
6. Stem: Bronze.
7. Disc: Solid wedge; bronze.
8. Packing: Asbestos free.
9. Handwheel: Malleable iron, bronze, or aluminum.

B. Gate Valves, Flanged Ends - Iron, NRS, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. Crane Fluid Systems; Crane Co.
 - c. Kennedy Valve Company; a division of McWane, Inc.
2. Standard: MSS SP-70, Type I.
3. CWP Rating: 200 psig.

4. Body Material: Gray iron with bolted bonnet.
5. Ends: Flange.
6. Trim: Bronze.
7. Disc: Solid wedge.
8. Packing and Gasket: Asbestos free.

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. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves. Remove defective valves from site.

3.2 INSTALLATION OF VALVES

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Provide support of piping adjacent to valves such that no force is imposed upon valves.
- C. Locate valves for easy access and where not blocked by equipment, other piping, or building components.
- D. For valves in horizontal piping, install valves with stem at or above center of pipe.
- E. Install valves in position that does not project into aisles or block access to other equipment.

- F. Install valves in position to allow full stem and actuator or manual operator movement.
- G. Verify that joints of each valve have been properly installed and sealed to assure there is no leakage or damage.
- H. Check Valves: Install check valves for proper direction of flow.
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
- I. Valve Tags: Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
- J. Adhere to manufacturer's written installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's recommended maximum.

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 exhibiting leakage.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- B. Select valves with the following end connections:
 - 1. For Copper Tubing, 2 inch and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, 2-1/2 to 4 inch: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Copper Tubing, 5 inch and Larger: Flanged ends.
 - 4. For Steel Piping, 2 inch and Smaller: Threaded ends.
 - 5. For Steel Piping, 2-1/2 to 4 inch: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 6. For Steel Piping, 5 inch and Larger: Flanged ends.

3.5 DOMESTIC HOT- AND COLD-WATER BALL VALVE SCHEDULE

A. Pipe 2 inch and Smaller:

1. Ball valves, lead free, threaded or soldered ends - brass, two piece with full port and brass trim.

B. Pipe 2-1/2 inch and Larger:

1. Ball valves, lead free, flanged or threaded ends - iron, Class 125.

3.6 DOMESTIC HOT- AND COLD-WATER BUTTERFLY VALVE SCHEDULE

A. Pipe 2-1/2 inch and Larger:

1. Butterfly valves, lead free, single flange (lug type) - iron, with aluminum-bronze disc; 200 CWP, NBR seat.

3.7 DOMESTIC HOT- AND COLD-WATER CHECK VALVE SCHEDULE

A. Pipe 2 inch and Smaller:

1. Check valves, lead free, swing type, threaded or soldered ends - bronze, with bronze disc, Class 125.

B. Pipe 2-1/2 inch and Larger:

1. Check valves, lead free, swing type, flanged or threaded ends - iron, with metal seats, Class 125.

3.8 PUMP-DISCHARGE CHECK VALVE SCHEDULE

A. Pipe 2 inch and Smaller for Domestic Water Pumps:

1. Check valves, lead free, swing type, threaded or soldered ends - bronze, with bronze disc, Class 125.

B. Pipe 2 inch and Smaller for Sanitary Waste and Storm Drainage:

1. Check valves, lead free, swing type, threaded or soldered ends - bronze, with bronze disc, Class 150.

C. Pipe 2-1/2 inch and Larger for Domestic Water Pumps:

1. Check valves, lead free, swing type, flanged or threaded ends - iron, with lever- and spring-closure control, Class 125.

D. Pipe 2-1/2 inch and Larger for Sanitary Waste and Storm Drainage:

1. Check valves, swing type, flanged ends - iron, with lever- and spring-closure control, Class 125.

3.9 DOMESTIC HOT- AND COLD-WATER GATE VALVE SCHEDULE

A. Pipe 2 inch and Smaller:

1. Gate valves, lead free, threaded or soldered ends - bronze, NRS, Class 125.

B. Pipe 2-1/2 inch and Larger:

1. Gate valves, lead free, flanged ends - iron, NRS, Class 125.

END OF SECTION 22 05 23

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SECTION 22 05 29 - 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. Metal framing systems.
4. Thermal hanger-shield inserts.
5. Fastener systems.
6. Pipe-positioning systems.
7. Equipment supports.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 220500 "Common Work Results for Plumbing."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Equipment supports.

C. Delegated Design Submittals: 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. Detail fabrication and assembly of trapeze hangers.
2. Include design calculations for designing trapeze hangers.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1.
- B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.
- 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, including pipe stands, 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.

2.2 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, hot-dip galvanized, or electro-galvanized.
3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
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 or stainless 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 and Tube 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 or stainless steel.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-58, 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.

2.4 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business.
 - b. Cooper B-line; brand of Eaton, Electrical Sector.

- c. Flex-Strut Inc.
 - d. Gripple Inc.
 - e. Unistrut; Atkore International.
- 2. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
 - 3. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 4. Channels: Continuous slotted carbon-steel channel with inturned lips.
 - 5. Channel Width: Selected for applicable load criteria.
 - 6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 - 7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.
 - 8. Paint Coating: Green epoxy, acrylic, or urethane.

2.5 THERMAL HANGER-SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Buckaroos, Inc.
 - 2. CADDY; brand of nVent Electrical plc.
 - 3. Carpenter & Paterson, Inc.
 - 4. National Pipe Hanger Corporation.
 - 5. Pipe Shields Inc.
 - 6. Piping Technology & Products, Inc.
 - 7. Rilco Manufacturing Co., Inc.
 - 8. Value Engineered Products, Inc.

- B. Insulation-Insert Material for Cold Piping: ASTM C552, Type II cellular glass with 100-psig or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with 100-psig, ASTM C552, Type II cellular glass with 100-psig or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 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.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - c. MKT Fastening, LLC.
- B. Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper B-line; brand of Eaton, Electrical Sector.
 - b. Hilti, Inc.
 - c. ITW Ramset/Red Head; Illinois Tool Works, Inc.

- d. MKT Fastening, LLC.
- 2. Indoor Applications: Zinc-coated or stainless steel.
- 3. Outdoor Applications: Stainless steel.

2.7 PIPE-POSITIONING SYSTEMS

- A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.8 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

2.9 MATERIALS

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011.
- C. Structural Steel: ASTM A36 carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A240.
- E. Grout: ASTM C1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 EXECUTION

3.1 APPLICATION

- A. 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.

3.2 INSTALLATION OF HANGERS AND SUPPORTS

- A. Do not support pipes or equipment from ducts, other pipes etc.
- B. Support piping so there is no strain on the connections to pumps and other equipment.
- C. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- D. Metal Trapeze Pipe-Hanger Installation: This is a delegated design to be completed by the contractor. Comply with MSS SP-58. 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 A36 carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- E. Framing System Installation: Metal; This is a delegated design to be completed by the contractor. Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- F. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.
- G. 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.
- H. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- I. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

- J. Equipment Support Installation: Fabricate from welded-structural-steel shapes. This is a delegated design to be completed by the contractor.
- K. Install lateral bracing with pipe hangers and supports to prevent swaying.
- L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, 2-1/2 inch 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.
- M. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- N. 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.
- O. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating Above Ambient Air Temperature: Galvanized or Painted Clamp may project through insulation.
 - b. Piping Operating Below Ambient Air Temperature: Use Galvanized or Painted 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. MSS SP-58, Type 39: Install 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 4 inch and larger if pipe is installed on rollers.
 - 3. MSS SP-58, Type 40: Install 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 4 inch and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:
 - a. 1/4 to 3-1/2 inches: 12 inches long and 0.048 inch thick.
 - b. 4 inches: 12 inches long and 0.06 inch thick.
 - c. 5 and 6 inches: 18 inches long and 0.06 inch thick.
5. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

3.3 INSTALLATION OF EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. This is a delegated design to be completed by the contractor.
- C. Grouting: Place grout under supports for equipment, and make bearing surface smooth.
- D. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 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 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.

3.5 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.

3.6 PAINTING

- A. Touchup:
 - 1. Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - a. 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 A780.

3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 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 finishes.
- 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, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper or stainless steel attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal hanger-shield inserts for insulated piping and tubing.

- I. 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 noninsulated or insulated, stationary pipes 1/2 to 30 inches.
 2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes 3/4 to 36 inches, requiring clamp flexibility and up to 4 inches of insulation.
 3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes 1/2 to 24 inches if little or no insulation is required.
 4. Pipe Hangers (MSS Type 5): For suspension of pipes 1/2 to 4, to allow off-center closure for hanger installation before pipe erection.
 5. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes 1/2 to 8 inches.
 6. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes 1/2 to 8 inches.
 7. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes 3/8 to 8 inches.
 8. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes 3/8 to 3 inches.
 9. U-Bolts (MSS Type 24): For support of heavy pipes 1/2 to 30 inches.
 10. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 11. Pipe Saddle Supports (MSS Type 36): For support of pipes 4 to 36 inches, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 12. Pipe Stanchion Saddles (MSS Type 37): For support of pipes 4 to 36 inches, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 13. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes 2-1/2 to 36 inches if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.

14. Single-Pipe Rolls (MSS Type 41): For suspension of pipes 1 to 30 inches, from two rods if longitudinal movement caused by expansion and contraction occurs.
 15. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes 2-1/2 to 24 inches, from single rod if horizontal movement caused by expansion and contraction occurs.
 16. Complete Pipe Rolls (MSS Type 44): For support of pipes 2 to 42 inches if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.
 17. Pipe Roll and Plate Units (MSS Type 45): For support of pipes 2 to 24 inches if small horizontal movement caused by expansion and contraction occurs and vertical adjustment is unnecessary.
 18. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes 2 to 30 inches if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.
- J. 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 3/4 to 24 inches.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers 3/4 to 24 inches if longer ends are required for riser clamps.
- K. 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 of up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 4. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- L. 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-joist 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. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. 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.
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

M. 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.

N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. 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.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected

equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

- a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- O. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Comply with MFMA-103 for metal framing system 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 22 05 29

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SECTION 22 05 48 - VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Restrained elastomeric isolation mounts.
2. Housed-spring isolators.
3. Spring hangers.
4. Snubbers.
5. Restraints - rigid type.
6. Restraints - cable type.
7. Restraint accessories.
8. Post-installed concrete anchors.
9. Concrete inserts.

B. Related Requirements:

1. Section 230548 "Vibration Controls for HVAC" for devices for HVAC equipment and systems.

1.2 DEFINITIONS

- ##### **A. IBC: International Building Code.**

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

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 vibration isolation device component.

3. Annotate to indicate application of each product submitted and compliance with requirements.
4. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
2. 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.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct testing indicated, be an NRTL as defined by OSHA in 29 CFR 1910.7 and be acceptable to authorities having jurisdiction.

B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Schedule of Isolation is included in this specification section.

B. Fire/Smoke Resistance: All components that are not constructed of ferrous metals must have a maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested by an NRTL in accordance with ASTM E84 or UL 723, and be so labeled.

C. Component Supports:

1. Load ratings, features, and applications of all reinforcement components must be based on testing standards of a nationally recognized testing agency.

- D. Select isolators for uniform static deflections according to distribution of weight and to meet requirements shown elsewhere in the Contract Documents.
- E. Select isolators for not less than the deflections indicated on the Schedule.
- F. Select vibration isolation for stable operation during starting and stopping of equipment without excessive movement of equipment.
- G. Corrosion Resistance: All springs and associated metal hardware shall be designed or treated for resistance to corrosion. Steel components shall be PVC coated, or phosphated and painted with industrial grade enamel. All nuts, bolts and washers shall be zinc electroplated. Structural steel bases and exposed steel components of concrete inertia bases shall be cleaned of welding slag and primed with zinc-chromate or metal etching primer. A finish coat of industrial grade enamel shall be applied over the primer.
- H. Outdoor Locations: Steel parts PVC coated, hot-dip galvanized, zinc-electroplated plus coating of neoprene, bitumastic paint, or powdered coating. Aluminum components for outdoor installation shall be etched and painted with industrial grade enamel. Nuts, bolts, and washers may be zinc-electroplated.
- I. Springs: all springs shall be fully color-coded to indicate capacity, color striping is not considered adequate.

2.2 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. ASHRAE Type 2

B. TYPE A

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. Korfund.
 - c. Mason Industries, Inc.
 - d. VMC GROUP.
 - e. Vibration Eliminator Co., Inc.

2. Description: All-directional isolator with 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.
3. Minimum deflection as scheduled.

2.3 HOUSED-SPRING ISOLATORS

A. ASHRAE Type 3

B. TYPE B

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. Korfund.
 - c. Mason Industries, Inc.
 - d. VMC GROUP.
 - e. Vibration Eliminator Co., Inc.
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. Minimum deflection as scheduled.
7. 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 psi.
- b. Top housing with attachment and leveling bolt, threaded mounting holes and internal leveling device or elastomeric pad as appropriate to handle the load.

2.4 SPRING HANGERS

A. ASHRAE Type 3

B. TYPE G

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. VMC GROUP.
 - d. Vibration Eliminator Co., Inc.
2. 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.
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. Minimum deflection as scheduled.
7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
8. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
9. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

C. TYPE H

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. VMC GROUP.
 - d. Vibration Eliminator Co., Inc.
2. Same as Type G except as follows:
 - a. Provide with spring deflection indicator, pre-compressed springs to support object at fixed elevation during installation.

2.5 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. VMC GROUP.
- B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
 1. Post-Installed Concrete Anchor Bolts: Secure to concrete surface with post-installed concrete anchors. Anchors to be prequalified in accordance with ACI 355.2 testing and designated in accordance with ACI 318-14 Ch. 17 for 2015 or 2018 IBC.
 2. Preset Concrete Inserts: Prequalified in accordance with ICC-ES AC446 testing.
 3. Anchors in Masonry: Design in accordance with TMS 402.
 4. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 5. Resilient Cushion: Maximum 1/4-inch air gap, and minimum 1/4 inch thick.

2.6 RESTRAINTS - RIGID TYPE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper B-line; brand of Eaton, Electrical Sector.
 2. Hilti, Inc.
 3. Unistrut; Atkore International.
 4. VMC GROUP.
- B. Description: Shop- or field-fabricated bracing assembly made of AISI S110-07-S1 slotted steel channels, ANSI/ASTM A53/A53M steel pipe as per NFPA 13, or other rigid steel brace member. Includes 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.

2.7 RESTRAINTS - CABLE TYPE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. CADDY; brand of nVent Electrical plc.
 2. Cooper B-line; brand of Eaton, Electrical Sector.
 3. Gripple Inc.
 4. Loos & Co. Inc.
 5. VMC GROUP.
- B. Restraint Cables: ASTM A1023 galvanized or ASTM A603 galvanized-steel. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with fittings attached by means of poured socket, swaged socket, or mechanical (Flemish eye) loop.
- C. Restraint cable assembly and cable fittings must comply with ASCE/SEI 19-10. All cable fittings and complete cable assembly must maintain the minimum cable breaking force. U-shaped cable clips and wedge-type end fittings do not comply and are unacceptable.

2.8 RESTRAINT ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-line; brand of Eaton, Electrical Sector.
 - 2. Hilti, Inc.
 - 3. Mason Industries, Inc.
 - 4. Unistrut; Atkore International.
- B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- D. 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.
- E. 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.
- F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.9 POST-INSTALLED CONCRETE ANCHORS

- A. Mechanical Anchor Bolts:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper B-line; brand of Eaton, Electrical Sector.
 - b. Hilti, Inc.
 - c. Mason Industries, Inc.
 - d. Unistrut; Atkore International.

2. 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 for anchor and as tested according to ASTM E488.

B. Adhesive Anchor Bolts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper B-line; brand of Eaton, Electrical Sector.
 - b. Hilti, Inc.
 - c. Mason Industries, Inc.
 - d. Unistrut; Atkore International.
2. Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

C. Provide post-installed concrete anchors that have been prequalified for use in wind-load applications. Post-installed concrete anchors must comply with all requirements of ASCE/SEI 7-05, Ch. 13, ASCE/SEI 7-10, Ch. 13, ASCE/SEI 7-16, Ch. 13.

1. Prequalify post-installed anchors in concrete in accordance with ACI 355.2 or other approved qualification testing procedures.
2. Prequalify post-installed anchors in masonry in accordance with approved qualification procedures.

D. Expansion-type anchor bolts are not permitted for equipment in excess of 10 hp that is not vibration isolated.

1. Undercut expansion anchors are permitted.

2.10 CONCRETE INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-line; brand of Eaton, Electrical Sector.

2. Hilti, Inc.
 3. Mason Industries, Inc.
 4. Unistrut; Atkore International.
- B. Provide preset concrete inserts that are prequalified in accordance with ICC-ES AC466 testing.
- C. Comply with ANSI/MSS SP-58.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners as follows and where required to prevent buckling of hanger rods due to wind-load forces.
 1. Throughout mechanical equipment rooms but, not less than 50 feet from the isolated equipment where the first 50 feet extends past the mechanical equipment room wall. The pipe shall not come in contact with the wall or sleeve.
 2. For the first 50 feet if not in a mechanical equipment room.
 3. Within 50 feet of pressure reducing valves.
- C. Strength of Support Assemblies: The minimum static deflection of the first three hangers shall equal that of the isolators supporting the equipment. Thereafter, provide isolators with 1/2 the static deflection capabilities of the isolation system of the equipment to which it is connected.

3.3 INSTALLATION OF VIBRATION CONTROL DEVICES

- A. Provide vibration control devices for systems and equipment as scheduled in this section, where Specifications indicate they are to be installed on specific equipment and systems, and where required by applicable codes.
- B. Coordinate 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."
- C. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- D. Install isolators in locations to permit inspection and adjustment, and to provide proper operation. Install isolators as high as possible in hanger rod assembly, but clear of structure. Maintain 2-inch clearance between isolated equipment and walls, ceilings and other equipment. Maintain side clearance for hanger housings to allow a full 360-degree hanger rotation about the rod axis without contacting any object. Isolated systems shall be independently supported.
- E. Equipment Restraints:
 - 1. Install snubbers or thrust restraint isolation on plumbing equipment mounted on vibration isolators to prevent movement in excess of ¼-inch due to dynamic forces. Locate snubbers or thrust restraint as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 - 2. Mount equipment on steel base of adequate structural rigidity when equipment or frame is not structurally suitable for the type of isolation specified. Spring and rail and spring supports are specified on the basis that the equipment is structurally built or supported on a rigid frame. Isolators for equipment with bases shall be located on sides of the base, which are parallel to the equipment shaft.
 - 3. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
- F. 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.
- G. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- H. 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.
- I. 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. Provide structural base plate under isolator where isolator is wider than supporting structural member. Tack weld plate to structural member.
- J. Post-Installed Concrete 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 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-Type Anchor Bolts: 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-Type Anchor Bolts: 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 MOTION

- A. Provide flexible connections in piping systems where they cross structural joints and other point where differential movement may occur. Provide adequate flexibility to accommodate differential movement as determined in accordance with ASCE/SEI 7.

Comply with requirements in Section 221116 "Domestic Water Piping" and Section 221119 "Domestic Water Piping Specialties" for piping flexible connections.

3.5 INSTALLATION OF VIBRATION ISOLATION EQUIPMENT BASES

- A. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."
- B. Coordinate dimensions of equipment bases with requirements of isolated equipment specified in this and other Sections. Where dimensions of base are indicated on Drawings, they may require adjustment to accommodate isolated equipment.

3.6 EQUIPMENT ISOLATION SCHEDULE

- A. If the mount baseplate is bolted to structure or framework rigidly connected to the structure, elastomeric grommets shall be used between each bolt and the baseplate to prevent rigid connection. These additional neoprene washers and bushings may be omitted if the baseplate and friction pad incorporate neoprene elements that eliminate rigid contact between bolts and the baseplate. Bolt holes shall be properly sized to allow for bushing sleeve. The anchor bolt shall incorporate steel washers to distribute load evenly over neoprene washers.

B. Equipment Isolation Schedule

TYPE OF EQUIPMENT	SUPPORTING STRUCTURE			
	FLOOR SLAB ON EARTH		OTHER FLOOR AND ROOF	
	ISOLATION BASE TYPE	MIN. STATIC DEFLECTION IN INCHES	ISOLATION BASE TYPE	MIN. STATIC DEFLECTION IN INCHES
Packaged Pump Systems	A	0.75	A	1.5

C. Piping Isolation

1. Type A or B Mountings: Provide on all floor-supported piping.

2. Type G Hanger Isolators: Provide on all suspended piping, except for first three hanger points of each water pipe connected to vibration isolated pumps. Type G isolators shall be installed after the pipe is insulated.
3. Type H Hanger Isolators: Provide on all suspended piping for first three hanger points of each water pipe connected to vibration isolated pumps.
4. Provide flexible connection on suction and discharge piping connection to vibration isolated floor-mounted and vertical inline pumps as specified in section 221119 – “Domestic Water Piping Specialties.”
5. The installation of vibration isolators shall not cause any change of position of piping, that will result in stresses in piping connections or misalignment of shafts or bearings. Account for changes in height and weight when pipes are filled with water.
6. Resilient Penetration Sleeve/Seals: Provide penetration seals to maintain an airtight seal around penetrating elements and to prevent rigid contact of penetrating element and building construction. Fit sleeve tightly to building construction and seal airtight on both sides of construction penetrated with acoustic sealant.

3.7 ADJUSTING

- A. Adjust isolators after 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.
- C. Adjust leveling bolts and hanger rod bolts so that isolated equipment is level and in proper alignment with connecting ducts and pipes. All vibration isolators shall be aligned squarely above or below mounting points of supported equipment.

3.8 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections with the assistance of a factory-authorized service representative.
- 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.

END OF SECTION 22 05 48

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SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Warning tape.
4. Pipe labels.
5. Valve tags.
6. Warning tags.

1.2 ACTION SUBMITTALS

- A. Product Data:** For each type of product indicated.
- B. Equipment-Label Schedule:** Include a listing of all equipment to be labeled with the proposed content for each label.
- C. Valve-numbering scheme.**
- D. Valve Schedules:** For each piping system. Include in operation and maintenance manuals.

PART 2 PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Craftmark Pipe Markers.

- c. Seton Identification Products; a Brady Corporation company.
 - 2. Material and Thickness: Brass, 0.032-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
 - 3. Letter and Background Color: As indicated for specific application under Part 3.
 - 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 of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths 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. 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.

2.2 WARNING SIGNS AND LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. Brady Corporation.
 - 2. Craftmark Pipe Markers.
 - 3. Seton Identification Products; a Brady Corporation company.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, with predrilled holes for attachment hardware.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Maximum Temperature: Able to withstand temperatures of 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 of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths 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. Arc-Flash Warning Signs: Provide arc-flash warning signs in locations and with content in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.
- J. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 WARNING TAPE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Brady Corporation.
 - 2. Craftmark Pipe Markers.
 - 3. Seton Identification Products; a Brady Corporation company.
- B. Material: Vinyl.
- C. Minimum Thickness: 0.005 inch.
- D. Letter, Pattern, and Background Color: As indicated for specific application under Part 3.
- E. Waterproof Adhesive Backing: Suitable for indoor or outdoor use.
- F. Maximum Temperature: 160 deg F.
- G. Minimum Width: 2 inches.

2.4 PIPE LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
 2. Craftmark Pipe Markers.
 3. Seton Identification Products; a Brady Corporation company.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- E. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- F. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:
1. Pipe size.
 2. Flow-Direction Arrows: Include flow-direction arrows on distribution piping. Arrows may be either integral with label or applied separately.
 3. Lettering Size: At least 1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.

2.5 VALVE TAGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Brady Corporation.
 2. Craftmark Pipe Markers.
 3. Seton Identification Products; a Brady Corporation company.
- B. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
1. Tag Material: Brass, 0.04-inch minimum thickness, with predrilled or stamped holes for attachment hardware.

2. Fasteners: Brass wire link chain or beaded chain or S-hook.

C. Letter and Background Color: As indicated for specific application under Part 3.

D. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Include valve-tag schedule in operation and maintenance data.

2.6 WARNING TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Craftmark Pipe Markers.
3. Seton Identification Products; a Brady Corporation company.

B. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Reinforced grommet and wire or string.
3. Nomenclature: Large-size primary caption, such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Letter and Background Color: As indicated for specific application under Part 3.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION, GENERAL REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

- A. Permanently fasten labels on each item of plumbing equipment.
- B. Sign and Label Colors.
 - 1. White letters on an ANSI Z535.1 safety-green background.
- C. Locate equipment labels where accessible and visible.
- D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where arc-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.
- E. Equipment requiring identification.
 - 1. Domestic Water Heaters
 - 2. Expansion Tanks
 - 3. Pumps
 - 4. Variable Frequency Motor Controllers
 - 5. Water Mixing Valves

3.4 INSTALLATION OF WARNING TAPE

- A. Warning Tape Color and Pattern: Yellow background with black diagonal stripes.
- B. Install warning tape on pipes and ducts, with cross-designated walkways providing less than 6 ft. of clearance.

- C. Locate tape so as to be readily visible from the point of normal approach.

3.5 INSTALLATION OF PIPE LABELS

- A. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
- 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 and plenums; and exterior exposed locations as follows:
 - 1. Within 3 ft. of each valve and control device.
 - 2. At access doors and similar access points that permit view of concealed piping.
 - 3. Within 3 ft. of equipment items and other points of origination and termination.
 - 4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in mechanical equipment rooms.
- C. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.
- D. Flow-Direction Flow Arrows: Use arrows, in compliance with ASME A13.1, to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- E. Pipe-Label Color Schedule:
 - 1. Domestic Cold-Water: White letters on an ANSI Z535.1 safety-green background.
 - 2. Domestic Hot-Water: White letters on an ANSI Z535.1 safety-green background.
 - 3. Domestic Hot-Water Return: White letters on an ANSI Z535.1 safety-green background.
 - 4. Sanitary Waste: White letters on a black background.
 - 5. Sanitary Vent: White letters on a black background.
 - 6. Storm Drainage: White letters on a black background.
 - 7. Secondary Storm Water: White letters on a black background.

8. Tempered Water: Black letters on an ANSI Z535.1 safety-yellow background.
9. Nonpotable Cold Water: Black letters on an ANSI Z535.1 safety-yellow background.
10. Condensate: White letters on an ANSI Z535.1 safety-green background.

3.6 INSTALLATION OF VALVE TAGS

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule in the operating and maintenance manual.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:
 1. Valve-Tag Size and Shape: 1-1/2 inches round.
 2. Valve-Tag Colors:
 - a. For each piping system, use the same lettering and background coloring system on valve tags as used in the piping system labels and background.

3.7 INSTALLATION OF WARNING TAGS

- A. Warning Tag Color: Black letters on an ANSI Z535.1 safety-yellow background.
- B. Attach warning tags, with proper message, to equipment and other items where indicated on Drawings and scheduled.

END OF SECTION 22 05 53

SECTION 22 05 93 - TESTING, ADJUSTING, AND BALANCING FOR PLUMBING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. TAB of domestic water system.
2. TAB of plumbing equipment:
 - a. Domestic water booster pumps.
 - b. Domestic hot-water in-line circulation pumps.
 - c. Drainage pumps.
3. Pipe-leakage test verification.
4. Testing, adjusting, and balancing of existing plumbing systems and equipment.

1.2 DEFINITIONS

- A. NEBB: National Environmental Balancing Bureau.
- B. TAB: Testing, adjusting, and balancing.
- C. TABB: Testing, Adjusting, and Balancing Bureau.
- D. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- E. TDH: Total dynamic head.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 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. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists, as specified in "Preparation" Article.
- E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.
- F. Certified TAB reports.
- G. Sample report forms.
- H. 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.

1.4 QUALITY ASSURANCE

- A. TAB Specialists Qualifications, Certified by NEBB or TABB:
 - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB.
 - 2. TAB Technician: Employee of the TAB specialist and certified by NEBB or TABB.
- B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- C. ASHRAE 111 Compliance: Requirements in ASHRAE 111 applicable to analogous domestic water system and plumbing equipment balancing.
- D. ASHRAE 188 Compliance: Comply with balancing and report requirements, Section 8.3 "Balancing."

- E. Code and Authorities Having Jurisdiction Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

1.5 FIELD CONDITIONS

- A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 TAB SPECIALISTS

- A. Subject to compliance with requirements, engage one of the following:

[Certification Directory \(nebb.org\)](http://nebb.org)

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 installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, and balancing valves and fittings. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine approved submittals for plumbing systems and equipment.
- D. Examine design data, including plumbing system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about plumbing system and equipment controls.
- E. Examine equipment performance data, including pump curves.
 - 1. Relate performance data to Project conditions and requirements, including pump system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate pump system-effect factors to reduce performance ratings of plumbing equipment when installed under conditions different from the conditions used to

rate equipment performance. Compare results with the design data and installed conditions.

- F. Examine system and equipment installations, and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- G. Examine test reports specified in individual system and equipment Sections.
- H. Examine plumbing equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- I. Examine temporary and permanent strainers. Verify that temporary strainer screens used during system cleaning and flushing have been removed and permanent strainers are installed and clean.
- J. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.
- K. Examine system pumps to ensure absence of entrained air in the suction piping.
- L. Examine operating safety interlocks and controls on plumbing equipment.
- M. 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 the following:
 - 1. Equipment and systems to be tested.
 - 2. Strategies and step-by-step procedures for balancing the systems.
 - 3. Instrumentation to be used.
 - 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of plumbing systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
 - 1. Domestic Water System:

- a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed in accordance with applicable code and authority having jurisdiction.
- b. Water heaters are installed and functioning.
- c. Piping is complete and all points of outlet are installed.
- d. Water treatment is complete.
- e. Systems are flushed, filled, and air purged.
- f. Strainers are clean.
- g. Shutoff and balance valves are 100 percent open.
- h. Booster and hot-water circulating pumps are operational and proper rotation is verified.
- i. Pump gauge connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
- j. Variable-frequency controllers' startup is complete and safeties are verified.
- k. Suitable access to balancing devices and equipment is provided.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system in accordance with the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
- B. Cut insulation, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. Where holes for probes are required in piping or equipment, install pressure and temperature test plugs to seal systems.
 - 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 220716 "Plumbing Equipment Insulation" and Section 220719 "Plumbing Piping Insulation."

- C. Mark equipment and balancing devices, including valve position indicators and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.5 GENERAL PROCEDURES FOR PLUMBING EQUIPMENT

- A. Test, adjust, and balance plumbing equipment indicated on Drawings, including, but not limited to, the following:
 - 1. Motors.
 - 2. Domestic water booster pumps.
 - 3. Domestic water in-line pumps.
 - 4. Domestic water heaters.
 - 5. Drainage pumps.

3.6 PROCEDURES FOR DOMESTIC WATER SYSTEMS

- A. Prepare test reports for pumps and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required equipment flow rates with system design flow rates.
- B. Prepare schematic diagrams of systems' Record drawings piping layouts.
- C. In addition to requirements in "Preparation" Article, prepare domestic water systems for testing and balancing as follows:
 - 1. Check expansion tank for proper setting.
 - 2. Check water heater for proper discharge temperature setting.
 - 3. Check remotest point of outlet for adequate pressure.
 - 4. Check flow-control valves for proper position.
 - 5. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
 - 6. Verify that motor controllers are equipped with properly sized thermal protection.

7. Check that air has been purged from the system.

D. Measure and record upstream and downstream pressure of each piece of equipment.

E. Measure and record upstream and downstream pressure of pressure-reducing valves.

F. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.

G. Check settings and operation of each safety valve. Record settings.

3.7 PROCEDURES FOR DOMESTIC WATER SYSTEM BOOSTER PUMPS

A. Adjust pumps to deliver total design flow.

1. Measure total water flow.

a. Position valves for full flow through coils.

b. Measure flow by main flow meter, if installed.

c. If main flow meter is not installed, determine flow by pump TDH or known equipment pressure drop.

2. Measure pump TDH as follows:

a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.

b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.

c. Convert pressure to head and correct for differences in gauge heights.

d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.

e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved. If excessive throttling is required to achieve desired flow, recommend pump impellers be trimmed to reduce excess throttling.

3. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.

B. Adjust flow-measuring devices installed in mains and branches to design water flows.

1. Measure flow in main and branch pipes.
2. Adjust main and branch balance valves for design flow.
3. Re-measure each main and branch after all have been adjusted.

C. Verify final system conditions as follows:

1. Re-measure and confirm that total water flow is within design.
2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
3. Mark final settings.

D. Verify that memory stops have been set.

3.8 PROCEDURES FOR DOMESTIC HOT-WATER CIRCULATING INLINE PUMP

A. Balance system with manual or automatic balancing valves by setting at design flow.

1. Measure flow in main and branch pipes.
2. Adjust main and branch balance valves for design flow.
3. Re-measure each main and branch after all have been adjusted.

B. Adjust pump to deliver total design flow.

1. Measure pump TDH as follows:
 - a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
 - b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
 - c. Convert pressure to head and correct for differences in gauge heights.
 - d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.

2. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.
3. Mark final settings and verify that all memory stops have been set.
4. Verify final system conditions as follows:
 - a. Re-measure and confirm that total flow is within design.
 - b. Re-measure final pumps' operating data, TDH, volts, amps, speed, and static profile.
 - c. Mark final settings.

3.9 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. Phase and hertz.
 5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Starter size and thermal-protection-element rating.
 8. Service factor and frame size.
- B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.10 PROCEDURES FOR WATER HEATERS

- A. Electric Water Heaters:
1. Measure and record entering- and leaving-water temperatures.
 2. Measure and record water flow.

3. Measure and record pressure drop.
4. Measure and Record relief valve(s) pressure setting.
5. Capacity: Calculate in Btu/h (kW) of heating output.
6. Efficiency: Calculate operating efficiency for comparison to submitted equipment.

3.11 TOLERANCES

A. Set plumbing system's flow rates within the following tolerances:

1. Domestic Water Flow Rate: Plus or minus 10 percent. If design value is less than 10 gpm, within 10 percent.

3.12 PROGRESS REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to plumbing systems and general construction to allow access for performance-measuring and -balancing devices.
- B. Status Reports: Prepare monthly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.13 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.
 3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Pump curves.

2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. 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 specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents, including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Notes to explain why certain final data in the body of reports vary from indicated values.
14. Test conditions for pump performance forms, including the following:

- a. Variable-frequency controller settings for variable-flow hydronic systems.
 - b. Settings for pressure controller(s).
 - c. Other system operating conditions that affect performance.
- D. Electric Water Heater Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
- 1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Model number and unit size.
 - d. Manufacturer's serial number.
 - e. Output capacity in Btu/h (kW).
 - f. Number of stages.
 - g. Connected volts, phase, and hertz.
 - h. Rated amperage.
 - 2. Test Data (Indicated and Actual Values):
 - a. Heat output in Btu/h.
 - b. Entering-water temperature in deg F.
 - c. Leaving-water temperature in deg F.
 - d. High-temperature-limit setting in deg F.
 - e. Operating set point in deg F.
 - f. Voltage at each connection.
 - g. Amperage for each phase.
- E. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves, and include the following:

1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model number and serial number.
 - f. Water flow rate in gpm.
 - g. Water-pressure differential in feet of head or psig.
 - h. Required net positive suction head in feet of head or psig.
 - i. Pump speed.
 - j. Impeller diameter in inches.
 - k. Motor make and frame size.
 - l. Motor horsepower and rpm.
 - m. Voltage at each connection.
 - n. Amperage for each phase.
 - o. Full-load amperage and service factor.
 - p. Seal type.
2. Test Data (Indicated and Actual Values):
 - a. Static head in feet of head or psig.
 - b. Pump shutoff pressure in feet of head or psig.
 - c. Actual impeller size in inches.
 - d. Full-open flow rate in gpm.
 - e. Full-open pressure in feet of head or psig.

- f. Final discharge pressure in feet of head or psig.
- g. Final suction pressure in feet of head or psig.
- h. Final total pressure in feet of head or psig.
- i. Final water flow rate in gpm.
- j. Voltage at each connection.
- k. Amperage for each phase.

F. Instrument Calibration Reports:

- 1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.14 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Construction Manager/Commissioning Authority.
- B. Commissioning Authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to the lesser of either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- C. 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."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the TAB shall be considered incomplete and shall be rejected.

E. If recheck measurements find the number of failed measurements noncompliant with requirements indicated, proceed as follows:

1. TAB specialists shall 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. All changes shall be tracked to show changes made to previous report.
2. If the second final inspection also fails, Owner may pursue other Contract options to complete TAB work.

F. Prepare test and inspection reports.

3.15 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

END OF SECTION 22 05 93

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SECTION 22 07 19 - PLUMBING PIPING INSULATION

PART 1 GENERAL

1.1 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Domestic recirculating hot-water piping.
4. Storm-water.
5. Roof drains and rainwater leaders.
6. Supplies and drains for handicap-accessible lavatories and sinks.
7. Condensate and equipment drain piping.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. 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 insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 3. Detail removable insulation at piping specialties, equipment connections, and access panels.
 4. Detail application of field-applied jackets.
 5. Detail application at linkages of control devices.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.4 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. Preference will be given to those who have successfully completed a manufacturer's installation training program, such as the 'Armcell Qualified Installer Program' (AQIP) or similar.
- B. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation system materials are to be delivered to the Project site in unopened containers. The packaging is to include name of the manufacturer, fabricator, type, description, and size, as well as ASTM standard designation and maximum use temperature.

1.6 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and. Insulation application may begin on segments that have satisfactory test results.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84 or UL723, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
 - 1. All Insulation Installed Indoors and Outdoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," and "Indoor Piping Insulation Schedule," articles for where insulating materials are applied.
- B. Products do not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F and 220 deg F. Comply with ASTM C534, Type I for tubular materials.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA.
 - b. Armacell LLC.

- c. K-Flex USA.

G. Glass-Fiber, Preformed Pipe: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 850 deg F in accordance with ASTM C411. Comply with ASTM C547.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. Knauf Insulation.
 - c. Manson Insulation Inc.
 - d. Owens Corning.
2. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ.
3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.3 INSULATING CEMENTS

A. Glass-Fiber Insulating Cement: Comply with ASTM C195.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ramco Insulation, Inc.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C196.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ramco Insulation, Inc.

C. Glass-Fiber Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. Ramco Insulation, Inc.

2.4 ADHESIVES

A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric Adhesive: Solvent-based adhesive.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA.
 - b. Armacell LLC.
 - c. Foster Brand; H. B. Fuller.
 - d. K-Flex USA.
- 2. Flame-spread index is 25 or less and smoke-developed index is 50 or less as tested in accordance with ASTM E84.
- 3. Wet Flash Point: Below 0 deg F.
- 4. Service Temperature Range: 40 to 200 deg F.
- 5. Color: Black.

C. Glass-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller.
 - c. Mon-Eco Industries, Inc.

D. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Childers Brand; H. B. Fuller Construction Products.
- b. Foster Brand; H. B. Fuller.
- c. Mon-Eco Industries, Inc.

E. PVC Jacket Adhesive: Compatible with PVC jacket.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. P.I.C. Plastics, Inc.
 - c. Proto Corporation.
 - d. Speedline Corporation.
 - e. The Dow Chemical Company.

2.5 MASTICS AND COATINGS

A. Materials are compatible with insulation materials, jackets, and substrates.

B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller.
 - c. Knauf Insulation.
 - d. Mon-Eco Industries, Inc.
 - e. Vimasco Corporation.
- 2. Water-Vapor Permeance: Comply with ASTM E96 or ASTM F1249.
- 3. Service Temperature Range: 0 to plus 180 deg F.

4. Color: White.

2.6 LAGGING ADHESIVES

A. Adhesives comply with MIL-A-3316C, Class I, Grade A, and are compatible with insulation materials, jackets, and substrates.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller.
 - c. Vimasco Corporation.
2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
3. Service Temperature Range: 20 to plus 180 deg F.
4. Color: White.

2.7 SEALANTS

A. Materials are as recommended by the insulation manufacturer and are compatible with insulation materials, jackets, and substrates.

B. Joint Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller.
 - c. Mon-Eco Industries, Inc.
 - d. Owens Corning.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 58 to plus 176 deg F.

4. Color: White or gray.

C. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.8 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 C1136, Type I.

2.9 FIELD-APPLIED JACKETS

- A. Field-applied jackets comply with ASTM C1136, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Airex Manufacturing Inc.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. P.I.C. Plastics, Inc.
 - d. Proto Corporation.
 - e. Speedline Corporation.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. 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.

2.10 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Mesh: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
- B. Woven Polyester Mesh: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Foster Brand; H. B. Fuller.
 - b. Vimasco Corporation.

2.11 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Cloth: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Alpha Associates, Inc.

2.12 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Industrial Adhesives and Tapes Division.
 - b. Avery Dennison Corporation, Specialty Tapes Division.
 - c. Ideal Tape Co., Inc., an American Biltrite Company.
 - d. Knauf Insulation.
 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. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Industrial Adhesives and Tapes Division.
 - b. Ideal Tape Co., Inc., an American Biltrite Company.
 2. Width: 2 inches.
 3. Thickness: 6 mils.
 4. Adhesion: 64 ounces force/inch in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch in width.

2.13 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. RPR Products, Inc.
2. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. 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 Products.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. RPR Products, Inc.

2.14 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Buckaroos, Inc.
 - b. MVG Molded Products.
 - c. McGuire Manufacturing.
 - d. Plumberex Specialty Products, Inc.
 - e. ProFlo; a Ferguson Enterprises, Inc. brand.

- f. Truebro; IPS Corporation.
 - g. Zurn Industries, LLC.
 - h. Oatey Co.
- 2. 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.

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. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.3 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 of 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, compress, or otherwise damage insulation or jacket.

- D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) 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 storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents.
- 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 attached to structure with vapor-barrier mastic.
 - 3. Install insert materials and 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, but not to the extent of creating wrinkles or areas of compression in the insulation.

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 4 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape, in accordance with 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.

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 in similar fashion 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.

3.4 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 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 Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.

3.5 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 below.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.

2. Insulate pipe elbows using preformed fitting insulation made from same material and density as that of adjacent pipe insulation. Each piece is 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 of same material and thickness as that 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 of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 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 of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 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, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
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, 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.

- 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 that requires removal for maintenance, adjustment, inspection, etc. Installation conforms 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 that of adjoining pipe insulation.
 - 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 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 (50 mm) 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.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Install insulation in accordance with manufacturer's installation instructions or ASTM C1710.
- B. 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.
- C. Insulation Installation on Pipe Flanges:
 - 1. Slide un-slit sections over open ends of piping or tubing.
 - 2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation.

3. Install insulation in compression to allow for expansion and contraction.
4. Push insulation onto pipe, do not pull insulation onto pipe.
5. For below-ambient temperature systems, adhere insulation to pipe at least every 18 ft. using manufacturer's recommended adhesive. Terminate joints at critical points, including flanges, T-sections, elbows, supports, and similar fittings.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install sections of pipe insulation and miter if required in accordance with manufacturer's written instructions.
2. Install pipe insulation to outer diameter of pipe flange.
3. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
4. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments
5. 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.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated valve covers manufactured of same material as that of pipe insulation when available.
2. When prefabricated 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 GLASS-FIBER 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 jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with 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 prefabricated 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 glass-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 prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated 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 prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated sections are not available, install fabricated 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 FIELD-APPLIED JACKETS

- 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 overlap at seams and joints.
 2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- 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.

3.9 FINISHES

- A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
- B. Tests and Inspections: 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 is 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 if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.11 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.

3.12 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

- 1. 1 inch and Smaller: Insulation is one of the following:
 - a. Flexible Elastomeric: 1/2 inch thick.
 - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick. With vapor barrier.
- 2. 1-1/4 inch and Larger: Insulation is one of the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick. With vapor barrier.

B. Domestic Hot and Recirculated Hot Water:

- 1. 1-1/4 inch and Smaller: Insulation is one of the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- 2. 1-1/2 inch and Larger: Insulation is one of the following:
 - a. Flexible Elastomeric: 1 inch thick.

- b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

C. Stormwater and Overflow:

- 1. All Pipe Sizes: Insulation is one of the following:
 - a. Flexible Elastomeric: 1 inch thick. With vapor barrier.
 - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick. With vapor barrier.

D. Roof Drain and Overflow Drain Bodies:

- 1. All Pipe Sizes: Insulation is one of the following:
 - a. Flexible Elastomeric: 1 inch thick. With vapor barrier.
 - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick. With vapor barrier.

E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

- 1. All Pipe Sizes: Insulation is one of the following:
 - a. Flexible Elastomeric: 1/2 inch thick.
 - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

F. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:

- 1. All Pipe Sizes: Insulation is one of the following:
 - a. Flexible Elastomeric: 3/4 inch thick. With vapor barrier.
 - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick. With vapor barrier.

G. Condensate and Equipment Drain Water:

- 1. All Pipe Sizes: Insulation is one of the following:
 - a. Flexible Elastomeric: 3/4 inch thick. With vapor barrier.

- b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick. With vapor barrier.

3.13 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. ASJ
- D. Piping, Exposed 10 feet or less above finished floor and throughout mechanical equipment rooms.
 - 1. Field-Applied Fabric-Reinforcing Mesh
 - 2. Field-Applied Cloths

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SECTION 22 11 13 - FACILITY WATER DISTRIBUTION 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 RELATED SECTIONS

- A. Excavation, trenching, and backfilling shall comply with DelDOT Section 207.

1.3 SUMMARY

- A. This Section includes water-distribution piping and related components outside the building for combined water service and fire-service mains.

1.4 DEFINITIONS

- A. PVC: Polyvinyl chloride plastic.
- B. HDPE: High Density Polyethylene

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings (where applicable):
 - 1. Piping and tubing (water services)
 - 2. Tracer Wire
 - 3. Metallic Marking Tape
 - 4. Fittings
 - 5. Valves
 - 6. Yard Hydrants

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.

- B. Field quality-control test reports.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.8 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 F645 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 Annex G for materials for water-service piping and specialties for domestic water.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

- B. During Storage: Use precautions for valves according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.

2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. 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.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.
- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.10 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 10 days in advance of proposed interruption of service.
 2. Do not proceed with interruption of water-distribution service without Owner's written permission.

1.11 COORDINATION

- A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 PVC 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 200, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
 4. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

- a. Gaskets: AWWA C111, rubber.
- 5. 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 PE PIPE AND FITTINGS

- A. PE, ASTM Pipe: ASTM D2239, SDR No. 5.3, 7, or 9; with PE compound number required to give pressure rating not less than 200 psig.
 - 1. Insert Fittings for PE Pipe: ASTM D2609, made of PA, PP, or PVC with serrated male insert ends matching inside of pipe. Include bands or crimp rings.
 - 2. Molded PE Fittings: ASTM D3350, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.
- B. PE, AWWA Pipe: AWWA C906, DR No. 7.3, 9, or 9.3; with PE compound number required to give pressure rating not less than 200 psig.
 - 1. PE, AWWA Fittings: AWWA C906, socket- or butt-fusion type, with DR number matching pipe and PE compound number required to give pressure rating not less than 200 psig.

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.

2.4 GATE VALVES

- A. AWWA, Cast-Iron Gate Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American AVK Co.
 - b. American Cast Iron Pipe Company.
 - c. Clow Valve Company; a subsidiary of McWane, Inc.
 - d. Crane; Crane Energy Flow Solutions.
 - e. East Jordan Iron Works, Inc.
 - f. Flomatic Corporation.
 - g. Kennedy Valve Company; a division of McWane, Inc.
 - h. M & H Valve Company; a division of McWane, Inc.
 - i. McWane, Inc.
 - j. Mueller Co.
 - k. NIBCO INC.

- l. Tyler Pipe; a subsidiary of McWane Inc.
 - m. U.S. Pipe and Foundry Company.
 - n. Zurn Industries, LLC.
 - o. Approved Equal
2. Nonrising-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

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Cast Iron Pipe Company.
 - b. Clow Valve Company; a subsidiary of McWane, Inc.
 - c. East Jordan Iron Works, Inc.
 - d. Flowserve Corporation.
 - e. Kennedy Valve Company; a division of McWane, Inc.
 - f. M & H Valve Company; a division of McWane, Inc.
 - g. McWane, Inc.
 - h. Mueller Co.
 - i. U.S. Pipe and Foundry Company.
 - j. Approved Equal
 2. 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, ductile iron or stainless steel 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. Yard Hydrants: Yard hydrants shall be non-freeze post type with ¾-inch IPS pipe connections and ¾-inch threaded hose connection. Yard hydrant shall have cast bronze casing, neoprene plunger, removable bronze operation parts, aluminum protective shield, and shall be 30 inches in height above finished grade. The yard hydrant shall be equipped with vacuum breaker and three foot burial depth unless otherwise directed by the Owner or Owner's representative.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavation, trenching, and backfilling shall comply with DelDOT Section 207.

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, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.
- E. Water mains to be abandoned.
- F. Underground water-service piping NPS ¾ to NPS 3 shall be:
 - 1. PE, ASTM pipe; molded PE fittings; and heat-fusion joints.
- G. Underground water-service piping NPS 4 to NPS 8 shall be:
 - 1. PVC, AWWA C-900 Class 150, gasketed pipe; mechanical 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 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, stainless steel, resilient wedge seated gate valves with valve box.

2. Pressure-Reducing Valves: Use for water-service piping in vaults and aboveground to control water pressure.
3. Relief Valves: Use for water-service piping in vaults and aboveground.
 - a. Air-Release Valves: To release accumulated air.
 - b. Air/Vacuum Valves: To release or admit large volume of air during filling of piping.

3.4 PIPING INSTALLATION

- A. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.
- B. 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.
- C. Make connections NPS 2 and smaller with drilling machine according to the following:
 1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company standards.
 2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
 3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
 4. Install corporation valves into service-saddle assemblies.
 5. Install manifold for multiple taps in water main.
 6. Install curb valve in water-service piping with head pointing up and with service box.
- D. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.
- E. Bury piping with depth of cover over top at least 42 inches, unless otherwise directed by Engineer.
- F. 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.
- G. 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.

3.5 JOINT CONSTRUCTION

- A. Make pipe joints according to the following:
 - 1. PE Piping Insert-Fitting Joints: Use plastic insert fittings and fasteners according to fitting manufacturer's written instructions.
 - 2. 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.

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. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.
- C. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.

3.7 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 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. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
 - c. 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 22 11 13

SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper tube and fittings - domestic water.
2. Ductile-iron pipe and fittings - domestic water.
3. Piping joining materials - domestic water.
4. Transition fittings - domestic water.
5. Dielectric fittings - domestic water.

B. Related Requirements:

1. Section 331415 "Site Water Distribution Piping" for water-service piping outside the building from source to the point where water-service piping enters the building.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Copper tube and fittings - domestic water.
2. Ductile-iron pipe and fittings - domestic water.
3. Piping joining materials - domestic water.
4. Transition fittings - domestic water.
5. Dielectric fittings - domestic water.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Piping layout, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
- B. System purging and disinfecting activities report.

- C. Field quality-control reports.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Domestic water piping, tubing, fittings, joints, and appurtenances intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PIPING MATERIALS

- A. Potable-water piping and components are to comply with NSF 14, NSF 61, and NSF 372. Include marking "NSF-pw" on piping.

2.3 COPPER TUBE AND FITTINGS - DOMESTIC WATER

- A. Drawn-Temper Copper Tube: ASTM B88, Type L.
- B. Annealed-Temper Copper Tube: ASTM B88, Type K.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings. Solder joints on pipe sizes greater than 4 inches shall be made only by a qualified technician.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings. Solder joints on pipe sizes greater than 4.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Solder joints on pipe sizes greater than 4.
- F. Cast Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends. Solder joints on pipe sizes greater than 4.
- G. Wrought Copper Unions: ASME B16.22. Solder joints on pipe sizes greater than 4.

2.4 DUCTILE-IRON PIPE AND FITTINGS - DOMESTIC WATER

- A. Standard-Pattern, Push-on Joint Fittings:
 - 1. AWWA C110/A21.10, ductile or gray iron.

2. Gaskets: AWWA C111/A21.11, rubber.

- B. Plain-End, Ductile-Iron Pipe: AWWA C151/A21.51.

2.5 PIPING JOINING MATERIALS - DOMESTIC WATER

- 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 B32, lead-free alloys.

- D. Flux: ASTM B813, water flushable.

- E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.6 TRANSITION FITTINGS - DOMESTIC WATER

- 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 Couplings - Domestic Water: AWWA C219.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cascade Waterworks Mfg. Co.
 - b. Dresser Pipeline Solutions.

- c. Ford Meter Box Company, Inc. (The).
 - d. JCM Industries, Inc.
 - e. Jay R. Smith Mfg Co; a division of Morris Group International.
 - f. Romac Industries, Inc.
 - g. Smith-Blair, a Xylem brand.
 - h. Viking Johnson.
2. Source Limitations: Obtain sleeve-type transition couplings from single manufacturer.

2.7 DIELECTRIC FITTINGS - DOMESTIC WATER

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 - Domestic Water:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A.Y. McDonald Mfg. Co.
 - b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - c. HART Industrial Unions, LLC.
 - d. Jomar Valve.
 - e. Matco-Norca.
 - f. WATTS; A Watts Water Technologies Company.
 - g. Zurn Industries, LLC.
- 2. Source Limitations: Obtain dielectric unions from single manufacturer.
- 3. Standard: ASSE 1079.
- 4. Pressure Rating: 125 psig minimum at 180 deg F.

5. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges - Domestic Water:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. GF Piping Systems: Georg Fischer LLC.
 - c. Matco-Norca.
 - d. WATTS; A Watts Water Technologies Company.
 - e. Zurn Industries, LLC.
2. Source Limitations: Obtain dielectric flanges from single manufacturer.
3. Standard: ASSE 1079.
4. Factory-fabricated, bolted, companion-flange assembly.
5. Pressure Rating: 125 psig minimum at 180 deg F. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits - Domestic Water:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, LLC.
 - b. CALPICO, Inc.
 - c. GPT; a division of EnPRO Industries.
2. Source Limitations: Obtain dielectric-flange insulating kits from single manufacturer.
3. Nonconducting materials for field assembly of companion flanges.
4. Pressure Rating: 150 psig.

5. Gasket: Phenolic, Temperature Rating: 225 deg F.
6. Bolt Sleeves: Phenolic or polyethylene.
7. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples - Domestic Water:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International/Smith-Cooper International; Tailwind Capital, LLC.
 - b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - c. Matco-Norca.
 - d. Sioux Chief Manufacturing Company, Inc.
 - e. Victaulic Company.
2. Source Limitations: Obtain dielectric nipples from single manufacturer.
3. Standard: IAPMO PS 66.
4. Electroplated steel nipple complying with ASTM F1545.
5. Pressure Rating and Temperature: 300 psig at 225 deg F.
6. End Connections: Male threaded or grooved.
7. Lining: Inert and noncorrosive, propylene.

PART 3 EXECUTION

3.1 PIPING APPLICATIONS

- 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. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing when allowed by code.

- D. Under-building-slab, domestic water, building-service piping, 3 inches and smaller is to be the following:
 - 1. Annealed-temper copper tube, ASTM B88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
- E. Under-building-slab, domestic water, building-service piping, 4 to 8 inches and larger is to be the following:
 - 1. Annealed-temper copper tube, ASTM B88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
 - 2. Push-on joint, ductile-iron pipe; standard-pattern, push-on joint fittings; and gasketed joints.
- F. Under-building-slab, domestic water piping, 2 inches and smaller is to be the following:
 - 1. Drawn-temper copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and brazed joints.
- G. Aboveground domestic water piping, 2 inches and smaller is to be the following:
 - 1. Drawn-temper copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and brazed joints.
- H. Aboveground domestic water piping, 2-1/2 to 4 inches is to be the following:
 - 1. Drawn-temper copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and brazed joints.

3.2 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 220500 "Common Work Results for Plumbing."

3.3 INSTALLATION OF PIPING

- 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 copper tubing under building slab in accordance with CDA's "Copper Tube Handbook."

- C. Install ductile-iron piping under building slab with restrained joints in accordance with AWWA C600 and AWWA M41.
- D. Install underground copper tube and ductile-iron pipe in PE encasement in accordance with ASTM A674 or AWWA C105/A21.5.
- E. Install valves in accordance with the following:
 - 1. Section 220523 "General Duty Valves for Plumbing Piping."
- F. 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.
- G. Install fittings for changes in direction and branch connections.
- H. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- I. Use reducing fittings to make changes in pipe sizes.
- J. Install pressure gauges on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gauges in Section 220500 "Common Work Results for Plumbing."
- K. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123.21 "Inline, Domestic Water Pumps."
- L. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220500 "Common Work Results for Plumbing."
- M. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220500 "Common Work Results for Plumbing."
- N. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220500 "Common Work Results for Plumbing."
- O. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220500 "Common Work Results for Plumbing."

P. Workmanship

1. Cut pipes accurately to measurements established at structure.
2. Install without springing or forcing.
3. Clear windows, doors, and other openings.
4. Permit expansion and contraction without misalignment or damage.
5. During construction, close openings in piping and equipment to keep out foreign matter and to prevent leakage.
6. Piping shall be concealed unless otherwise indicated.
7. Install domestic water piping level without pitch and plumb.
8. Provide offsets required to avoid structural or other interference without extra cost to the Owner.
9. Provide hose end drain valves at bottom of risers, low points and where indicated.
10. Install piping free of sags and bends.
11. Install piping to permit valve servicing. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
12. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
13. 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.

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 pipes, tubes, and fittings before assembly.

- C. Threaded Joints: Thread pipe with tapered pipe threads in accordance with 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. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.
- E. Extruded-Tee Connections: Form tee in copper tube in accordance with ASTM F2014. 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.
- F. 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 in accordance with ASME B31.9.
- G. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.5 INSTALLATION OF TRANSITION FITTINGS

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. Fittings for 1-1/2 inch and Smaller: Fitting-type coupling.
 - 2. Fittings for 2 inch and Larger: Sleeve-type coupling.

3.6 INSTALLATION OF DIELECTRIC FITTINGS

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for 2 inch and Smaller: Use dielectric couplings, nipples or unions as required.
- C. Dielectric Fittings for 2-1/2 to 4 inches: Use dielectric flanges, flange kits or nipples as required.
- D. Dielectric Fittings for 5 inches and Larger: Use dielectric flange kits.

3.7 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Install hangers for copper and ductile iron and tube and pipe, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Support horizontal piping within 12 inches of each fitting.
- D. Support vertical runs of copper and ductile iron tube and pipe to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.8 PIPING 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.

3.9 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

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 in accordance with 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 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.

3.12 FIELD QUALITY CONTROL

A. 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 installation 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.

END OF SECTION 22 11 16

SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 GENERAL

1.1 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 for domestic water piping.
7. Hose bibbs.
8. Wall hydrants.
9. Roof Hydrants
10. Drain valves.
11. Water-hammer arresters.
12. Trap-seal primer device.
13. Trap-seal primer systems.
14. Flexible connectors.

B. Related Requirements:

1. Section 220500 "Common Work Results for Plumbing."

1.2 ACTION SUBMITTALS

- ##### **A. Product Data:** For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Test and inspection reports.
- B. Field quality-control reports.

1.4 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. Domestic water piping specialties intended to convey or dispense water for human consumption are to comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or to be certified in compliance with NSF 61 and NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

- A. Hose-Connection Vacuum Breakers <**ASSE 1011**>:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. WATTS; A Watts Water Technologies Company.
 - c. Woodford Manufacturing Company.
 - d. Zurn Industries, LLC.
 - e. Jay R. Smith Mfg Co; a division of Morris Group International.
2. Standard: ASSE 1011.

3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Rough bronze.

2.4 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers <ASSE 1013>:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Fire & Waterworks; A Watts Water Technologies Company.
 - b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - c. FEBCO; A WATTS Brand.
 - d. WATTS; A Watts Water Technologies Company.
 - e. Zurn Industries, LLC.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle third of flow range.
5. Size: 2 inch.
6. Design Flow Rate: 60 gpm.
7. Selected Unit Flow Range Limits: 190 gpm.
8. Pressure Loss at Design Flow Rate: 10 psig for sizes 2 inches and smaller.
9. Body: Bronze, cast silicon copper alloy or stainless steel for 2 inch and smaller; ductile or cast iron with interior lining that complies with AWWA C550 or that is FDA approved or stainless steel for 2-1/2 inch and larger.
10. End Connections: Threaded for 2 inch and smaller; flanged for 2-1/2 inch and larger.
11. Configuration: Designed for horizontal, straight-through flow.

12. Accessories:

- a. Valves 2 inch and Smaller: Ball type with threaded ends on inlet and outlet.
- b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

B. Hose-Connection Backflow Preventers <ASSE 1052>

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. WATTS; A Watts Water Technologies Company.
 - c. Woodford Manufacturing Company.
 - d. Zurn Industries, LLC.
- 2. Standard: ASSE 1052.
- 3. Operation: Up to 10-foot head of water back pressure.
- 4. Inlet Size: 3/4 inch.
- 5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
- 6. Capacity: At least 3-gpm flow.

C. Backflow-Preventer Test Kits

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Fire & Waterworks; A Watts Water Technologies Company.
 - b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - c. FEBCO; A WATTS Brand.
 - d. WATTS; A Watts Water Technologies Company.
 - e. Zurn Industries, LLC.

2. Description: Factory calibrated, with gauges, fittings, hoses, and carrying case with test-procedure instructions.

2.5 BALANCING VALVES

A. Memory-Stop Balancing Valves

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. Crane Fluid Systems; Crane Co.
 - c. Hammond Valve.
 - d. Jenkins Valves; a Crane Co. brand.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Stockham; a Crane Co. brand.
2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig minimum CWP.
4. Size: 2 inch or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass or stainless steel.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

2.6 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Individual-Fixture, Water Tempering Valves: **TV-1**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company; a Division of Morris Group International.
 - b. Lawler Manufacturing Company, Inc.
 - c. POWERS; A WATTS Brand.
 - d. Zurn Industries, LLC.
 - e. Acorn Controls; a Division of Morris Group International.
2. Standard: ASSE 1070, thermostatically controlled, water tempering valve.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Material: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Connections: Threaded inlets and outlet.
7. Finish: Chrome plated.
8. Tempered-Water Setting: See contract drawings.
9. Tempered-Water Design Flow Rate: See contract drawings.

2.7 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Keckley Company.
 - b. Titan Flow Control, Inc.
 - c. WATTS; A Watts Water Technologies Company.
 - d. Zurn Industries, LLC.
 - e. Caleffi North America.

2. Pressure Rating: 125 psig minimum unless otherwise indicated.
3. Body: Bronze for 2 inch and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for 2-1/2 inch and larger.
4. End Connections: Threaded for 2 inch and smaller; flanged for 2-1/2 inch and larger.
5. Screen: Stainless steel with round perforations unless otherwise indicated.
1. Perforation Size:
 - a. Strainers 2 inch and Smaller: 0.020 inch.

2.8 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; a division of Morris Group International.
 - b. MIFAB, Inc.
 - c. WATTS; A Watts Water Technologies Company.
 - d. Woodford Manufacturing Company.
 - e. Zurn Industries, LLC.
 - f. Josam Company.
2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Bronze.
4. Seat: Bronze, replaceable.
5. Supply Connections: 1/2 or 3/4 inch 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 Service Areas: Rough bronze.
11. Finish for Finished Rooms: Chrome or nickel plated.
12. Operation for Equipment Rooms: Wheel handle or operating key.
13. Operation for Service Areas: Wheel handle.
14. Operation for Finished Rooms: Operating key.
15. Include operating key with each operating-key hose bibb.
16. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.9 WALL HYDRANTS

A. Nonfreeze Wall Hydrants <WH>:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. MIFAB, Inc.
 - c. WATTS; A Watts Water Technologies Company.
 - d. Woodford Manufacturing Company.
 - e. Zurn Industries, LLC.
 - f. Josam Company.
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: 3/4 or 1 inch.
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: Polished nickel bronze.

2.10 ROOF HYDRANTS

A. Nonfreeze, Non-Draining-Type Roof Hydrants <RH-1>:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. MIFAB, Inc.
 - c. WATTS; A Watts Water Technologies Company.
 - d. Woodford Manufacturing Company.
 - e. Zurn Industries, LLC.
 - f. Woodford Manufacturing Company, LLC
2. Basis of Design: Woodford model SRH-MS or equal.
3. Standard: ASME A112.21.3M.
4. Type: Nonfreeze, exposed-outlet roof hydrant with coated cast-iron head and lift handle with lock option. Provide with deck flange and under deck clamp.
5. Casing and Operating Rod: Bronze interior parts, galvanized-steel casing, and bronze valve housing designed with hole to drain.
6. Inlet: 3/4 inch.
7. Outlet: Garden-hose thread complying with ASME B1.20.7.
8. 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.

2.11 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 minimum CWP.
3. Size: 3/4 inch.
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.

2.12 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters <PDI>:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Jay R. Smith Mfg Co; a division of Morris Group International.
 - c. MIFAB, Inc.
 - d. Precision Plumbing Products.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. WATTS; A Watts Water Technologies Company.
 - g. Zurn Industries, LLC.
 - h. Josam Company.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows or Diaphragm.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.13 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device <TYPE B>:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Precision Plumbing Products.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. WATTS; A Watts Water Technologies Company.
 - g. Zurn Industries, LLC.
2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: 1/2 inch threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: 1/2 inch threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.14 TRAP-SEAL PRIMER SYSTEMS

A. Trap-Seal Primer Systems <TYPE A>:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Precision Plumbing Products.
 - b. Sioux Chief Manufacturing Company, Inc.
 - c. Zurn Industries, LLC.
 - d. Jay R. Smith Mfg Co; a division of Morris Group International.
2. Standard: ASSE 1044.
3. Inlet Size: $\frac{3}{4}$ inch, ASTM B88, Type L; copper, water tubing.
4. Cabinet: Recessed-mounted steel box with stainless steel cover.
5. 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.
6. Vacuum Breaker: ASSE 1001.
7. Number Outlets: Four.
8. Size Outlets: $\frac{1}{2}$ inch.

2.15 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Flex-Hose Co., Inc.
 2. Mason Industries, Inc.
 3. Metraflex Company (The).
- B. 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.

2. End Connections 2 inch and Smaller: Threaded copper pipe or plain-end copper tube.
- C. 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.
 2. End Connections 2 inch and Smaller: Threaded steel-pipe nipple.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES

- A. Backflow Preventers: Install in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 1. Locate backflow preventers in same room as connected equipment or system.
 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
 3. Do not install bypass piping around backflow preventers.
- B. Balancing Valves: Install in locations where they can easily be adjusted. Set at indicated design flow rates.
- C. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- D. Y-Pattern Strainers: For water, install on supply side of each pump. Support strainers at pumps independent of piping system.
- E. Water-Hammer Arresters: Install in water piping in accordance with PDI-WH 201.
- F. Trap-Seal Primer Systems: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.2 PIPING CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

3.3 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

3.4 CONTROL CONNECTIONS

- A. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

3.5 IDENTIFICATION

- A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Vacuum breakers.
 - 2. Backflow preventers.
 - 3. Balancing valves.
 - 4. Temperature-actuated, water mixing valves.
 - 5. Wall hydrants.
 - 6. Trap-seal primer device.
 - 7. Trap-seal primer systems.
- 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 220553 "Identification for Plumbing Piping and Equipment."

3.6 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.
- D. Adjust each pressure vacuum breaker and reduced-pressure-principle backflow preventer in accordance with manufacturer's written instructions, authorities having jurisdiction and the device's reference standard.

3.7 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.
 - 1. Test each pressure vacuum breaker and reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.
 - 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 unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 22 11 19

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SECTION 22 11 23.13 - DOMESTIC-WATER PACKAGED BOOSTER PUMPS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Simplex, variable-speed booster pumps. Type A

1.2 DEFINITIONS

- A. VPMC: Variable-frequency motor controller.**

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and dimensions of individual components and profiles.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For booster pumps to include in emergency, operation, and maintenance manuals.**

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Retain protective coatings and flange's protective covers during storage.**

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.**

2.2 SIMPLEX, VARIABLE-SPEED BOOSTER PUMPS – TYPE A

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

1. Goulds: Xylem Brand.
2. Canariis Corporation.
3. Grundfos Pumps Corporation.
4. TIGERFLOW Systems, Inc.

B. Basis of Design: Xylem Aquavar e-AB2

C. Description: Factory-assembled and -tested, fluid-handling system for domestic water, with pump and controls.

D. Pump:

1. Type: End suction as defined in HI 1.1-1.2 and HI 1.3 for end-suction, close-coupled, single-stage, overhung-impeller, centrifugal pump.
2. Casing: 316L stainless steel.
3. Impeller: Closed, 316L stainless steel; statically and dynamically balanced and keyed to shaft.
4. Shaft and Shaft Sleeve: Steel shaft, with copper-alloy shaft sleeve and deflector.
5. Seal: Carbon / Silicon Carbide / EPR
6. Orientation: Mounted horizontally.

E. Motor: Inverter duty, with pre-greased, permanently shielded, ball-bearings, and directly mounted to pump casing. Select motor that will not overload through full range of pump performance curve.

F. Valves:

1. Shutoff Valves 2-1/2 inch and Smaller: field installed two-piece, full-port ball valve, in pump suction and discharge piping.
2. Check Valve: Field installed silent type in pump discharge piping.
3. Thermal-Relief Valve: Field installed temperature-and-pressure relief type in pump discharge piping.

G. Dielectric Fittings: With insulating material to isolate joined dissimilar metals.

H. VFMC: Serving each pump in pump array.

1. Manufactured Units: Pulse-width modulated; variable torque for inverter-duty motors.
2. Output Rating: Three phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.
3. Unit Operating Requirements:
 - a. Internal Adjustability:
 - 1) Minimum Speed: 5 to 25 percent of maximum rpm.
 - 2) Maximum Speed: 80 to 100 percent of maximum rpm.
 - 3) Acceleration: 0.1 to 999.9 seconds.
 - 4) Deceleration: 0.1 to 999.9 seconds.
 - 5) Current Limit: 30 to minimum of 150 percent of maximum rating.
 - b. Self-Protection and Reliability Features:
 - 1) Surge suppression.
 - 2) Loss of input signal protection.
 - 3) Under- and overvoltage trips.
 - 4) VFC and motor overload/overtemperature protection.
 - 5) Critical frequency rejection.
 - 6) Loss-of-phase protection.
 - 7) Reverse-phase protection.
 - 8) Motor-overtemperature fault.
 - c. Bidirectional autospeed search.
 - d. Torque boost.
 - e. Motor temperature compensation at slow speeds.

- 1) Panel-mounted operator station.
 - 2) Historical logging information and displays.
 - 3) Digital indicating devices.
- f. Control Signal Interface: Electric.
- g. PID control interface.
- h. DDC System for HVAC Protocols for Network Communications: ASHRAE 135.
4. Line Conditioning:
 - a. Input line conditioning.
 - b. Output filtering.
 - c. EMI/RFI filtering.
5. Low-suction-pressure cutout.
6. High-suction-pressure cutout.
7. Low-discharge-pressure cutout.
8. High-discharge-pressure cutout.
- I. Base: Structural steel.
- J. Capacities and Characteristics, as scheduled on the drawings.
 1. Hydropneumatic Tank:
 - a. Minimum Water Volume Capacity: 12 gal.
 - b. Pressure Rating: 125 psig.
 - c. Air Precharge: 60 psig.

2.3 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors.

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 throughout the pumps operating curve.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in NFPA 70.

2.4 SOURCE QUALITY CONTROL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- B. ASME Compliance: Comply with ASME B31.9 for piping.
- C. UL Compliance for Packaged Pumping Systems:
 1. UL 508, "Industrial Control Equipment."
 2. UL 508A, "Industrial Control Panels."
 3. UL 778, "Motor-Operated Water Pumps."
 4. UL 1995, "Heating and Cooling Equipment."

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for booster pumps to verify actual locations of piping connections before booster-pump installation.

3.2 INSTALLATION

- A. Booster-Pump Mounting:
 1. Comply with requirements for vibration isolation devices specified in Section 220548 "Vibration Controls for Plumbing Piping and Equipment."
- B. Support connected domestic-water piping so weight of piping is not supported by booster pumps.

3.3 PIPING CONNECTIONS

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Booster-Pump Piping Connections: Connect domestic-water piping to booster pumps. Connect with piping sizes as indicated on the drawings.

1. Install shutoff valves on piping connections to booster-pump suction and discharge headers for multiple pump installation and piping for single pump installation. Install isolation valves to pump system discharge and suction connections. Comply with requirements for general-duty valves specified in Section 221116 "Domestic Water Piping."
2. Install union, flanged, or grooved-joint connections on suction and discharge connections to booster system. Comply with requirements for unions and flanges specified in Section 221116 "Domestic Water Piping."
3. Install full sized valved bypass, around booster system. Comply with requirements for domestic-water piping specified in Section 221116 "Domestic Water Piping."
4. Install Type T hoses on suction and discharge connections to booster system. Comply with requirements with Section 220548 "Vibration Controls for Plumbing Piping and Equipment."
5. Where installing piping adjacent to booster pumps, allow space for service and maintenance.

3.4 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.

3.5 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.6 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
 - 1. Perform visual and mechanical inspection.
 - 2. Leak Test: After installation, charge booster pump and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start booster pumps to confirm proper motor rotation and booster-pump operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Pumps and controls will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.8 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.

3.9 ADJUSTING

- A. Adjust booster pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust pressure set points.

3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain booster pumps.

END OF SECTION 22 11 23.13

SECTION 22 11 23.21 - INLINE, DOMESTIC-WATER PUMPS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wet Rotor Pumps. Type C

B. Related Requirements:

1. Section 221123.13 "Domestic-Water Packaged Booster Pumps" for booster systems.

1.2 ACTION SUBMITTALS

- A. Product Data Submittals:** For each product. Include construction materials, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.**

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:** For inline, domestic-water pumps to include in operation and maintenance manuals.

1.5 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 instructions for handling.**

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: UL 778 for motor-operated water pumps.
- C. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.

2.2 WET-ROTOR PUMPS – TYPE C

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Armstrong Fluid Technology.
 - 2. Grundfos Pumps Corporation.
 - 3. ITT Corporation.
 - 4. Taco Comfort Solutions.
- B. Basis of Design: Taco 00 Series.
- C. Source Limitations: Obtain pumps from single source from single manufacturer.
- D. Description: Factory-assembled and -tested, wet-rotor pump. Pump and motor to form an integral unit with bearings lubricated by the pumped liquid.
- E. Pump Construction:
 - 1. Body: Cast iron.
 - 2. Impeller: Type 304 stainless steel.
 - 3. Pump Shaft: Type 316 stainless steel.
 - 4. Bearings. Double-sintered carbon.
- F. Motor: Single speed.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.
2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 220500 "Common Work Results for Plumbing."
 - a. Efficiency: Premium Efficiency.

2.3 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220500 "Common Work Results for Plumbing."
 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.

2.4 CONTROLS

- A. Thermostats: Electric; adjustable for control of hot-water circulation pump.
 1. Type: Water-immersion temperature sensor, for installation in piping.
 2. Range: 50 to 125 deg F.
 3. Enclosure: NEMA 250, Type 1.
 4. Operation of Pump: On or off.
 5. Transformer: Provide if required.
 6. Power Requirement: as required by contractor.
 7. Settings: Start pump at 105 deg F.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for domestic-water-piping system to verify actual locations of piping connections before pump installation.

3.2 INSTALLATION OF PUMPS

- A. Comply with HI 1.4.
- B. Mount pumps in orientation complying with manufacturer's written instructions.
- C. Install continuous-thread hanger rods and vibration isolation 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."
- D. Install thermostats in hot-water return piping.

3.3 PIPING CONNECTIONS

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to inline, domestic-water pumps, allow space for service and maintenance.
- C. Connect domestic-water piping to pumps. Install suction and discharge piping of size as indicated on drawings.
- D. Install accessories as indicated on the drawings.

3.4 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring between temperature controllers and devices.

3.5 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
- B. 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.
- C. Inline, domestic-water pump will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.7 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.

3.8 ADJUSTING

- A. Adjust inline, 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 22 11 23.21

SECTION 22 13 13 – FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Nonpressure-type transition couplings.
 - 2. Cleanouts.
 - 3. Concrete.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Fittings
 - 2. Cleanouts and cleanout caps
 - 3. Warning tape

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

- A. PVC Type PSM Sewer Piping:
 - 1. Pipe: ASTM D3034, SDR 35 sewer pipe with bell-and-spigot ends for gasketed joints.
 - 2. Fittings: ASTM D3034, PVC with bell ends.
 - 3. Gaskets: ASTM F477, elastomeric seals.

2.2 NONPRESSURE-TYPE TRANSITION COUPLINGS

- A. Comply with ASTM C1173, elastomeric, sleeve-type, reducing or transition coupling; for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and include corrosion-resistant-metal tension band and tightening mechanism on each end.
- B. Sleeve Materials:
 - 1. For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
 - 2. For Dissimilar Pipes: ASTM D5926, PVC or other material compatible with pipe materials being joined.

2.3 CONCRETE

- A. General: Cast-in-place concrete complying with ACI 318, and the following:
 - 1. Cement: ASTM C150/C150M, Type II.
 - 2. Fine Aggregate: ASTM C33/C33M, sand.
 - 3. Coarse Aggregate: ASTM C33/C33M, crushed gravel.
 - 4. Water: Potable.
- B. Portland Cement Design Mix: 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio.
 - 1. Reinforcing Fabric: ASTM A1064/A1064M, steel, welded wire fabric, plain.
 - 2. Reinforcing Bars: ASTM A615/A615M, Grade 60 (420-MPa) deformed steel.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavation, trenching, and backfilling shall comply with DelDOT Section 207.

3.2 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details to indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. 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 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.
- D. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
- E. Install gravity-flow, nonpressure, drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow, at minimum slope of 2 percent unless otherwise indicated.
 - 2. Install piping with 48-inch minimum cover.
 - 3. Install PVC Type PSM sewer piping according to ASTM D2321 and ASTM F1668.

- 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. Join gravity-flow, nonpressure, drainage piping according to the following:
 - 1. Join PVC Type PSM sewer piping according to ASTM D2321 and ASTM D3034 for elastomeric-seal joints or ASTM D3034 for elastomeric-gasket joints.
 - 2. Join dissimilar pipe materials with nonpressure-type, rigid couplings.

3.4 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318.

3.5 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at final grade.
 - 1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic
 - 2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic
 - 3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service
 - 4. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads
- B. Set cleanout frames and covers in concrete pavement and roads with tops flush with final pavement surface.

3.6 IDENTIFICATION

- A. Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.
 - 1. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

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 mandrel of size not less than 92.5 percent of piping diameter.
 - c. Damage: 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.
- 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 22 13 13

SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hub-and-spigot, cast-iron soil pipe and fittings.
2. Hubless, cast-iron soil pipe and fittings.
3. Specialty pipe fittings.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Hub-and-spigot, cast-iron soil pipe and fittings.
2. Hubless, cast-iron soil pipe and fittings.
3. Specialty pipe fittings.

B. Shop Drawings: For hubless, single-stack drainage system. Include plans, elevations, sections, and details.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and elevations, or Building Information Model (BIM) drawn to scale, showing items described in this Section and coordinated with all building trades.

B. Field quality-control reports.

1.4 WARRANTY

A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation are capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10 ft. head of water.

2.2 PIPING MATERIALS

- A. Piping materials to bear label, stamp, or other markings of specified testing agency.
- B. 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.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. AB & I Foundry; a part of the McWane family of companies.
 2. Charlotte Pipe and Foundry Company.
 3. Tyler Pipe; a part of McWane family of companies.
- B. Pipe and Fittings:
 1. Marked with CISPI collective trademark.
 2. ASTM A74, service or extra-heavy cast iron.
- C. Gaskets: ASTM C564, rubber.
- D. Caulking Materials: ASTM B29, pure lead and oakum or hemp fiber.

2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. AB & I Foundry; a part of the McWane family of companies.
 2. Charlotte Pipe and Foundry Company.
 3. Tyler Pipe; a part of McWane family of companies.
- B. Pipe and Fittings:
 1. Marked with CISPI collective trademark.

2. ASTM A888 or CISPI 301.

C. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AB & I Foundry; a part of the McWane family of companies.
 - b. ANACO-Husky.
 - c. Charlotte Pipe and Foundry Company.
 - d. Clamp-All Corp.
 - e. Dallas Specialty & Mfg. Co.
 - f. Ideal Tridon Group.
 - g. Mission Rubber Company, LLC; a division of MCP Industries.
 - h. Tyler Pipe; a subsidiary of McWane Inc.
2. Standards: ASTM C1540.
3. Description: Stainless steel shield with stainless steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.
4. Couplings shall have visual torque indicator to ensure proper torque is being applied.

2.5 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections of 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, Nonpressure Transition Couplings:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Dallas Specialty & Mfg. Co.
 - 2) Fernco Inc.
 - 3) Mission Rubber Company, LLC; a division of MCP Industries.
 - 4) Plastic Oddities.
 - b. Standard: ASTM C1173.
 - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. End Connections: Same size as and compatible with pipes to be joined.
 - e. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C564, rubber.
 - 2) For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926 PVC.
 - 3) For Dissimilar Pipes: ASTM D5926 PVC or other material compatible with pipe materials being joined.
4. Shielded, Nonpressure Transition Couplings:
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Mission Rubber Company, LLC; a division of MCP Industries.
 - b. Standard: ASTM C1460.
 - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. End Connections: Same size as and compatible with pipes to be joined.

5. Pressure Transition Couplings:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - 2) Cascade Waterworks Mfg. Co.
 - 3) EBAA Iron Sales, Inc.
 - 4) Ford Meter Box Company, Inc. (The).
 - 5) JCM Industries, Inc.
 - 6) Romac Industries, Inc.
- b. Standard: AWWA C219.
- c. Description: Metal sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
- d. Center-Sleeve Material: Manufacturer's standard.
- e. Gasket Material: Natural or synthetic rubber.
- f. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

- 1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- 2. Dielectric Unions:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) A.Y. McDonald Mfg. Co.
 - 2) Capitol Manufacturing Company.
 - 3) GF Piping Systems: Georg Fischer LLC.

- 4) HART Industrial Unions, LLC.
 - 5) Jomar Valve.
 - 6) Matco-Norca.
 - 7) WATTS; A Watts Water Technologies Company.
 - 8) Wilkins.
 - 9) Zurn Industries, LLC.
 - b. Description:
 - 1) Standard: ASSE 1079.
 - 2) Pressure Rating: 125 psig minimum at 180 deg F.
 - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
3. Dielectric Flanges:
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Capitol Manufacturing Company.
 - 2) GF Piping Systems: Georg Fischer LLC.
 - 3) Matco-Norca.
 - 4) WATTS; A Watts Water Technologies Company.
 - 5) Zurn Industries, LLC.
 - b. Description:
 - 1) Standard: ASSE 1079.
 - 2) Factory-fabricated, bolted, companion-flange assembly.
 - 3) Pressure Rating: 125 psig minimum at 180 deg F.
 - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

4. Dielectric-Flange Insulating Kits:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Advance Products & Systems, LLC.
 - 2) CALPICO, Inc.
 - 3) GF Piping Systems: Georg Fischer LLC.
 - 4) GPT; a division of EnPRO Industries.
 - b. Description:
 - 1) Nonconducting materials for field assembly of companion flanges.
 - 2) Pressure Rating: 150 psig.
 - 3) Gasket: Neoprene or phenolic.
 - 4) Bolt Sleeves: Phenolic or polyethylene.
 - 5) Washers: Phenolic with steel backing washers.
5. Dielectric Nipples:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Anvil International/Smith-Cooper International; Tailwind Capital, LLC.
 - 2) Elster Perfection; Honeywell.
 - 3) Matco-Norca.
 - 4) Precision Plumbing Products.
 - 5) Victaulic Company.
 - b. Description:
 - 1) Standard: IAPMO PS 66.

- 2) Electroplated steel nipple.
- 3) Pressure Rating: 300 psig at 225 deg F.
- 4) End Connections: Male threaded or grooved.
- 5) Lining: Inert and noncorrosive, propylene.

PART 3 EXECUTION

3.1 EARTH MOVING

- A. Excavating, trenching, and backfilling are specified in Section 220500 "Common Work Results for Plumbing."

3.2 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
 1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
 2. 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. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
 - 1. 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.
 - 2. 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.
 - a. Straight tees, elbows, and crosses may be used on vent lines.
 - 3. Do not change direction of flow more than 90 degrees.
 - 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
 - a. Reducing size of waste piping in direction of flow is prohibited.
- K. Lay buried building waste piping beginning at low point of each system.
 - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
 - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
 - 3. Maintain swab in piping and pull past each joint as completed.
- L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
 - 1. Building Sanitary Waste: Two percent downward in direction of flow for.
 - 2. Horizontal Sanitary Waste Piping: Two percent downward in direction of flow.
 - 3. Vent Piping: One percent down toward vertical fixture vent or toward vent stack.
- M. Install cast-iron soil piping in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- N. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
 - a. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
2. Install drains in sanitary waste gravity-flow piping.
 - a. 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.
 1. Comply with requirements for sleeves specified in Section 220500 "Common Work Results for Plumbing."
- Q. Install sleeve seals for piping penetrations of concrete walls and slabs.
 1. Comply with requirements for sleeve seals specified in Section 220500 "Common Work Results for Plumbing."
- R. Install escutcheons for piping penetrations of walls, ceilings, and floors.
 1. Comply with requirements for escutcheons specified in Section 220500 "Common Work Results for Plumbing."

3.3 JOINT CONSTRUCTION

- A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Hub-and-Spigot, Cast-Iron Soil Piping Caulked Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum caulked joints.
- C. Hubless, Cast-Iron Soil Piping Coupled Joints:
 1. Join hubless, cast-iron soil piping in accordance with CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- D. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1.

1. Cut threads full and clean using sharp dies.
2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
 - c. Do not use pipe sections that have cracked or open welds.

E. Joint Restraints and Sway Bracing:

1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:
 - a. Provide rigid sway bracing for pipe and fittings 4 inches and larger, upstream and downstream of all changes in direction 45 degrees and greater.

3.4 INSTALLATION OF SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.
2. In Underground Waste Drainage Piping: Unshielded, nonpressure transition couplings.
3. In Aboveground Waste Drainage Piping: Shielded, nonpressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for 2 inch and Smaller: Use dielectric unions.
3. Dielectric Fittings for 2-1/2 to 4 inch: Use dielectric flanges.

3.5 INSTALLATION OF VALVES

- A. General valve installation requirements for general-duty valve installation are specified in Section 220523 General Duty Valves for Plumbing Piping.
 - 1. Install shutoff valve on each sewage pump discharge.
 - 2. Install full-port ball valve for piping 2 inch and smaller.
 - 3. Install gate valve for piping 2-1/2 inch and larger.
- B. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

3.6 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment".
 - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 - 2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 - 3. Vertical Piping: MSS Type 8 or Type 42 clamps.
 - 4. Install individual, straight, horizontal piping runs:
 - a. 100 Ft. and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Ft.: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Ft. if Indicated: MSS Type 49, spring cushion rolls.
 - 5. Multiple, Straight, Horizontal Piping Runs 100 Ft. or Longer: MSS Type 44 pipe rolls. Support pipe rolls on trapeze.
 - 6. Base of Vertical Piping: MSS Type 52 spring hangers.
- B. Install hangers for cast-iron soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

- C. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- D. Support vertical runs of cast-iron soil piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

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 waste and vent piping to the following:
 - 1. Plumbing Fixtures: Connect waste 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 waste 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. Comply with requirements for cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 6. Equipment: Connect waste piping as indicated.
 - a. Provide shutoff valve if indicated and union for each connection.
 - b. Use flanges instead of unions for connections 2-1/2 inch and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections in accordance with the following unless otherwise indicated:
 - 1. Install unions, in piping 2 inch and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping 2-1/2 inch 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.
- B. 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 waste and vent piping in accordance with 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.
 - a. 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 waste and vent piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
 - a. Close openings in piping system and fill with water to point of overflow, but not less than 10 ft. head of water.

- b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
 - c. 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.
 - a. 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.
 - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
 - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
 - d. 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.

3.10 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping 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. 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 10 inch and smaller are to be the following:
 - 1. Service 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. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- C. Aboveground, vent piping 10 inch and smaller is to be the following:
1. Service cast iron, 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. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- D. Underground, soil, waste, and vent piping less than 10 feet of cover are to be the following:
1. Service cast-iron soil piping; gaskets; and gasketed joints.
 2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- E. Underground, soil and waste piping 10 feet of cover or greater are to be the following:
1. Extra-heavy, cast-iron soil piping; gaskets; and gasketed joints.
 2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.

END OF SECTION 22 13 16

SECTION 22 13 19 - SANITARY WASTE PIPING SPECIALTIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cleanouts.
2. Miscellaneous sanitary drainage piping specialties.

B. Related Requirements:

1. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashing assemblies.
2. Section 221423 "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.

1.2 ACTION SUBMITTALS

- A. Product Data:** For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.**

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:** For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

- A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.**

2.2 CLEANOUTS

- A. Cast-Iron Exposed Cleanouts**

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. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Tyler Pipe; a subsidiary of McWane Inc.
 - e. WATTS; A Watts Water Technologies Company.
 - f. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M.
3. Size: Same as connected drainage piping
4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Wall Cleanouts

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. WATTS; A Watts Water Technologies Company.
 - e. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.

4. Body: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure Plug:
 - a. Cast iron.
 - b. Countersunk head.
 - c. Drilled and threaded for cover attachment screw.
 - d. Size: Same as or not more than one size smaller than cleanout size.
6. Wall Access, Cover Plate: Round, flat, chrome-plated brass or stainless steel cover plate with screw.
7. Wall Access, Frame and Cover: Round, nickel-bronze, copper-alloy, or stainless steel wall-installation frame and cover.

2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with 1/2 inch side inlet.

B. Air-Gap Fittings

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

C. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

D. 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.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 1. Size same as drainage piping up to 4 inch. Use 4 inch 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 4 inch and smaller and 100 feet for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. 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.

- E. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- F. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.
- G. Install wood-blocking reinforcement for wall-mounting-type specialties.
- H. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 PIPING CONNECTIONS

- A. Comply with requirements in Section 221316 "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.

3.3 LABELING AND IDENTIFYING

- A. 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.
 - 1. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 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

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SECTION 22 13 19.13 - SANITARY DRAINS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Floor drains.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 PRODUCTS

2.1 DRAIN ASSEMBLIES

A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains <FD-1>:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - 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. Anchor Flange: Required.

6. Clamping Device: Required.
7. Outlet: Bottom.
8. Coating on Interior and Exposed Exterior Surfaces: Not required.
9. Sediment Bucket: Not required.
10. Top or Strainer Material: Bronze.
11. Top of Body and Strainer Finish: Nickel bronze.
12. Top Shape: Round.
13. Dimensions of Top or Strainer: 6 inch.
14. Top Loading Classification: Heavy Duty.
15. Funnel: Not required.
16. Inlet Fitting: Not required.
17. Trap Material: Cast iron.
18. Trap Pattern: Standard P-trap.
19. Trap Features: Trap-seal primer valve drain connection.

PART 3 EXECUTION

3.1 INSTALLATION

- A. 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.
 3. 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.
- 4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.
 - a. Maintain integrity of waterproof membranes where penetrated.
- 5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

3.2 CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Comply with requirements in Section 221319 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices and miscellaneous sanitary drainage piping specialties.
- C. Install piping adjacent to equipment to allow service and maintenance.

3.3 LABELING AND IDENTIFYING

- A. 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 220553 "Identification for Plumbing Piping and Equipment."

3.4 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 19.13

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SECTION 22 14 14 – STORM DRAINAGE PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hub-and-spigot, cast-iron soil pipe and fittings.
2. Hubless, cast-iron soil pipe and fittings.
3. Copper tube and fittings.
4. Specialty pipe fittings.

B. Related Requirements:

1. Section 221429 "Sump Pumps" for storm drainage pumps.
2. Section 334200 "Stormwater Conveyance" for storm drainage piping outside the building.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Hub-and-spigot, cast-iron soil pipe and fittings.
2. Hubless, cast-iron soil pipe and fittings.
3. Copper tube and fittings.
4. Specialty pipe fittings.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans and elevations, or Building Information Model (BIM) drawn to scale, showing items described in this Section and coordinated with all building trades.
- B. Field Quality-Control Reports: Inspection reports signed by authorities having jurisdiction.

1.4 QUALITY ASSURANCE

- A. Provide materials bearing label, stamp, or other markings of specified testing agency.

1.5 WARRANTY

- A. Listed manufacturers to provide labeling and warranty of their respective products

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation are to be capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Storm Drainage Piping: 10-foot head of water.
 - 2. Storm Drainage, Force-Main Piping: 50 psi.

2.2 PIPING MATERIALS

- A. Piping materials to bear label, stamp, or other markings of specified testing agency.
- B. 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.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AB & I Foundry; a part of the McWane family of companies.
 - 2. Charlotte Pipe and Foundry Company.
 - 3. Tyler Pipe; a part of McWane family of companies.
- B. Pipe and Fittings:
 - 1. Marked with CISPI collective trademark and NSF certification mark.
 - 2. Standard: ASTM A74.
 - 3. Class: Service weight and Extra heavy cast iron.

C. Gaskets: ASTM C564, rubber.

D. Caulking Materials: ASTM B29, pure lead and oakum or hemp fiber.

2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AB & I Foundry; a part of the McWane family of companies.
2. Charlotte Pipe and Foundry Company.
3. Tyler Pipe; a part of McWane family of companies.

B. Pipe and Fittings:

1. Marked with CISPI collective trademark and NSF certification mark.
2. Standards: ASTM A888 and CISPI 301.

C. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO-Husky.
 - b. Charlotte Pipe and Foundry Company.
 - c. Dallas Specialty & Mfg. Co.
 - d. Fernco Inc.
 - e. Ideal Tridon Group.
 - f. Mission Rubber Company, LLC; a division of MCP Industries.
2. Standard: ASTM C1540.
3. Description: Stainless steel shield with stainless steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.
4. Couplings shall have visual torque indicator to ensure proper installation torque is being applied.

2.5 COPPER TUBE AND FITTINGS

A. Copper Tube:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cambridge-Lee Industries, LLC.
 - b. Cerro Flow Products, LLC.
 - c. Wieland Copper Products, LLC.
2. Copper Type DWV Tube: ASTM B306, drainage tube, drawn temper.
3. Copper Tube, Drawn Temper: ASTM B88, Type L and Type M.
4. Copper Tube, Annealed Temper: ASTM B88, Type L.

B. Copper Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. NIBCO INC.
2. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
3. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
4. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
5. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
 - a. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - b. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder: ASTM B32, lead free with ASTM B813, water-flushable flux.

2.6 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections of 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, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Dallas Specialty & Mfg. Co.
 - 2) Fernco Inc.
 - 3) Mission Rubber Company, LLC; a division of MCP Industries.
 - b. Standard: ASTM C1173.
 - c. Description: Elastomeric sleeve, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C564 rubber.
 - 2) For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926 PVC.
 - 3) For Dissimilar Pipes: ASTM D5926 PVC or other material compatible with pipe materials being joined.
4. Shielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Dallas Specialty & Mfg. Co.
 - 2) Fernco Inc.
 - 3) Mission Rubber Company, LLC; a division of MCP Industries.
 - b. Standard: ASTM C1460.
 - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. End Connections: Same size as and compatible with pipes to be joined.
5. Pressure Transition Couplings:
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - 2) Cascade Waterworks Mfg. Co.
 - 3) EBAA Iron Sales, Inc.
 - 4) Ford Meter Box Company, Inc. (The).
 - 5) JCM Industries, Inc.
 - 6) Romac Industries, Inc.
 - b. Standard: AWWA C219.
 - c. Description: Metal, sleeve-type couplings same size as pipes to be joined, and with pressure rating at least equal to and ends compatible with pipes to be joined.
 - d. Center-Sleeve Material: Manufacturer's standard.
 - e. Gasket Material: Natural or synthetic rubber.
 - f. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) A.Y. McDonald Mfg. Co.
 - 2) Capitol Manufacturing Company.
 - 3) GF Piping Systems: Georg Fischer LLC.
 - 4) HART Industrial Unions, LLC.
 - 5) Jomar Valve.
 - 6) Matco-Norca.
 - 7) WATTS; A Watts Water Technologies Company.
 - 8) Wilkins.
 - 9) Zurn Industries, LLC.
 - b. Description:
 - 1) Standard: ASSE 1079.
 - 2) Pressure Rating: 150 psig minimum at 180 deg F.
 - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
3. Dielectric Flanges:
 - a. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1) Capitol Manufacturing Company.
 - 2) GF Piping Systems: Georg Fischer LLC.
 - 3) Matco-Norca.

- 4) WATTS; A Watts Water Technologies Company.
 - 5) Zurn Industries, LLC.
 - b. Description:
 - 1) Standard: ASSE 1079.
 - 2) Factory-fabricated, bolted, companion-flange assembly.
 - 3) Pressure Rating: 150 psig minimum at 180 deg F.
 - 4) End Connections: Solder-joint copper alloy and threaded ferrous.
- 4. Dielectric-Flange Insulating Kits:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Advance Products & Systems, LLC.
 - 2) CALPICO, Inc.
 - 3) GF Piping Systems: Georg Fischer LLC.
 - 4) GPT; a division of EnPRO Industries.
 - b. Description:
 - 1) Nonconducting materials for field assembly of companion flanges.
 - 2) Pressure Rating: 150 psig.
 - 3) Gasket: Neoprene or phenolic.
 - 4) Bolt Sleeves: Phenolic or polyethylene.
 - 5) Washers: Phenolic with steel-backing washers.
- 5. Dielectric Nipples:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Anvil International/Smith-Cooper International; Tailwind Capital, LLC.
 - 2) Elster Perfection; Honeywell.
 - 3) Matco-Norca.
 - 4) Precision Plumbing Products.
 - 5) Victaulic Company.
- b. Description: Electroplated steel nipple.
 - c. Standards: ASTM F492, ASME B1.20.1.
 - d. Pressure Rating: 300 psig at 225 deg F.
 - e. End Connections: Male threaded or grooved.
 - f. Lining: Inert and noncorrosive, propylene.

PART 3 EXECUTION

3.1 EARTH MOVING

- A. Excavating, trenching, and backfilling are specified in Section 220500 "Common Work Results for Plumbing."

3.2 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
- B. Install piping as indicated unless deviations from layout are approved on coordination drawings.
- C. Install piping in concealed locations.
 1. Piping installed in equipment rooms, service areas, and where indicated may be exposed.
- 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.

- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Make changes in direction for piping using appropriate branches, bends, and long-sweep bends.
 - 1. Do not change direction of flow more than 90 degrees.
 - 2. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
 - a. Reducing size of drainage piping in direction of flow is prohibited.
- L. Lay buried building piping beginning at low point of each system.
 - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
 - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
 - 3. Maintain swab in piping and pull past each joint as completed.
- M. Install piping at the following minimum slopes unless otherwise indicated.
 - 1. Building Storm Drain: 1/4 inch per foot (2 percent) downward in direction of flow.
 - 2. Horizontal Storm Drainage Piping: 1/4 inch per foot (2 percent) downward in direction of flow.
- N. Install cast-iron soil piping in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Ch IV, "Installation of Cast Iron Soil Pipe and Fittings."
- O. Install steel piping in accordance with applicable plumbing code.

P. Install aboveground copper tubing in accordance with CDA's "Copper Tube Handbook."

Q. Plumbing Specialties:

1. Install backwater valves in storm drainage gravity-flow piping.
 - a. Comply with requirements for backwater valves specified in Section 221423 "Storm Drainage Piping Specialties."
2. Install cleanouts in storm drainage gravity-flow piping in accessible locations.
 - a. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.
 - b. Comply with requirements for cleanouts specified in Section 221423 "Storm Drainage Piping Specialties."
3. Install drains in storm drainage gravity-flow piping.
 - a. Comply with requirements for drains specified in Section 221423 "Storm Drainage Piping Specialties."

R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

S. Install sleeves for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for sleeves specified in Section 220500 "Common Work Results for Plumbing."

T. Install sleeve seals for piping penetrations of concrete walls and slabs.

1. Comply with requirements for sleeve seals specified in Section 220500 "Common Work Results for Plumbing."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for escutcheons specified in Section 220500 "Common Work Results for Plumbing."

3.3 JOINT CONSTRUCTION

A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

- B. Hub-and-Spigot, Cast-Iron Soil Piping Caulked Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum caulked joints.
- C. Hubless, Cast-Iron Soil Piping Coupled Joints: Join in accordance with CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- D. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1.
 - 1. Cut threads full and clean using sharp dies.
 - 2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - a. Apply appropriate tape or thread compound to external pipe threads unless dry-seal threading is specified.
 - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
 - c. Do not use pipe sections that have cracked or open welds.
- E. Join copper tube and fittings with soldered joints in accordance with ASTM B828. Use ASTM B813, water-flushable, lead-free flux and ASTM B32, lead-free-alloy solder.
- F. 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.
- G. Joint Restraints and Sway Bracing:
 - 1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:
 - a. Provide axial restraint for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction, branches, and changes in diameter greater than two pipe sizes.
 - b. Provide rigid sway bracing for pipe and fittings 4 inches and larger, upstream and downstream of all changes in direction 45 degrees and greater.
 - c. Provide rigid sway bracing for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction and branch openings.

3.4 INSTALLATION OF SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.
2. In Underground Waste Drainage Piping: Unshielded, nonpressure transition couplings.
3. In Aboveground Waste Drainage Piping: Shielded, nonpressure transition couplings.
4. In Aboveground Force-Main Piping: Fitting-type transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for 2 inch and Smaller: Use dielectric unions.
3. Dielectric Fittings for 2-1/2 to 4 inch: Use dielectric flanges.
4. Dielectric Fittings for 5 inch and Larger: Use dielectric flange kits.

3.5 INSTALLATION OF VALVES.

A. General valve installation requirements for general-duty valve installation are specified in Section 220523 General Duty Valves for Plumbing Piping.

1. Install full-port ball valve for piping 2 inch and smaller.
2. Install gate valve for piping 2-1/2 inch and larger.

B. Check Valves: Install swing-check valve, between pump and shutoff valve, on each sump pump discharge.

C. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
2. Install backwater valves in accessible locations.

3. Comply with requirements for backwater valves specified in Section 221423 "Storm Drainage Piping Specialties."
4. Install horizontal backwater valves in header piping downstream from perforated subdrainage piping.

3.6 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for hangers, supports, and anchor devices 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 carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 3. Vertical Piping: MSS Type 8 or Type 42, clamps.
 4. 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.
 5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 6. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install hangers for cast-iron and copper soil tubing and piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- D. Support vertical cast-iron and copper tubing and piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent, but as a minimum at base and at each floor.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.
 - 1. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 - 2. Install horizontal backwater valves with cleanout cover flush with floor.
 - 3. Comply with requirements for backwater valves, cleanouts, and drains specified in Section 221423 "Storm Drainage Piping Specialties."
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections in accordance with the following unless otherwise indicated:
 - 1. Install unions, in piping 2 inch and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping 2-1/2 inch and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

- A. Identify exposed storm drainage piping.
- B. 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.

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 storm drainage piping in accordance with 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.
 - a. 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 storm drainage piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
 3. Test Procedure:
 - a. Test storm drainage piping, except outside leaders, on completion of roughing-in.
 - b. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
 - c. From 15 minutes before inspection starts until completion of inspection, water level must not drop.
 - d. Inspect joints for leaks.
 4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 5. Prepare reports for tests and required corrective action.
- E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials.
 - a. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

3.10 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.

3.11 PROTECTION

- A. Protect piping and drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of day and when work stops.
- C. Repair damage to adjacent materials caused by storm drainage piping installation.

3.12 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground storm drainage piping 6 inch and smaller is to be any of the following:
 1. Service weight, 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. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- C. Underground storm drainage piping 6 inch and smaller shall be any of the following:

1. Service weight, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- D. Underground, storm drainage piping 10 feet of cover or greater is to be the following:
1. Service weight, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- E. Aboveground storm drainage force mains 1-1/2 and 2 inch is to be any of the following:
1. Hard copper tube, Type L copper pressure fittings, and soldered joints.
- F. Air Conditioning Condensate, Condensate Pump Discharge and Humidifier Drainage:
1. Aboveground: Hard copper tube, Type L copper pressure fittings, and soldered joints.

END OF SECTION 22 14 14

SECTION 22 14 23 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. General-purpose roof drains.
2. Miscellaneous storm drainage piping specialties.
3. Cleanouts.

B. Related Requirements:

1. Section 076200 "Sheet Metal Flashing and Trim" for penetrations of roofs.

1.2 ACTION SUBMITTALS

A. Product Data:

1. General-purpose roof drains.
2. Miscellaneous storm drainage piping specialties.
3. Cleanouts.

1.3 QUALITY ASSURANCE

- A.** Provide drainage piping specialties are to bear label, stamp, or other markings of specified testing agency.

PART 2 PRODUCTS

2.1 GENERAL-PURPOSE ROOF DRAINS

A. Cast-Iron Roof Drains:

1. Cast-Iron, Large-Sump, Green Roof Primary Drains: **RD-1**.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Jay R. Smith Mfg Co; a division of Morris Group International.

- 2) Josam Company.
- 3) MIFAB, Inc.
- 4) Sioux Chief Manufacturing Company, Inc.
- 5) WATTS; A Watts Water Technologies Company.
- 6) Wade; a subsidiary of McWane Inc.
- 7) Zurn Industries, LLC.
- b. Basis of Design: Watts GRD-610.
- c. Standard: ASME A112.6.4.
- d. Body Material: Cast iron.
- e. Dimension of Body: Nominal 14-to 16-inch diameter.
- f. Dome Material: Cast iron.
- g. Combination flashing ring and gravel stop.
- h. Outlet: Bottom.
- i. Outlet Type: type to match drainage piping.
- j. Accessories:
 - 1) Flow-control weirs.
 - 2) Extension collars.
 - 3) Underdeck clamp.
 - 4) Expansion joint.
 - 5) Sump receiver plate.
 - 6) Perforated Gravel Guard: Stainless steel.
 - 7) Vandal-proof dome.
- 2. Cast-Iron, Large-Sump, Green Roof Secondary Drains: **RD-2**.

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Jay R. Smith Mfg Co; a division of Morris Group International.
 - 2) Josam Company.
 - 3) MIFAB, Inc.
 - 4) Sioux Chief Manufacturing Company, Inc.
 - 5) WATTS; A Watts Water Technologies Company.
 - 6) Wade; a subsidiary of McWane Inc.
 - 7) Zurn Industries, LLC.
- b. Basis of Design: Watts GRD-610-W.
- c. Standard: ASME A112.6.4.
- d. Body Material: Cast iron.
- e. Dimension of Body: Nominal 14-to 16-inch diameter.
- f. Dome Material: Cast iron.
- g. Combination flashing ring and gravel stop.
- h. Outlet: Bottom.
- i. Outlet Type: type to match drainage piping.
- j. Accessories:
 - 1) Flow-control weirs.
 - 2) Extension collars.
 - 3) Underdeck clamp.
 - 4) Expansion joint.
 - 5) Sump receiver plate.

- 6) Perforated Gravel Guard: Stainless steel.
 - 7) Vandal-proof dome.
 - 8) Water Dam: 2 inches high.
- 3. Cast-Iron, Small-Sump, Roof Drains: **RD-4**.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Jay R. Smith Mfg Co; a division of Morris Group International.
 - 2) Josam Company.
 - 3) MIFAB, Inc.
 - 4) Sioux Chief Manufacturing Company, Inc.
 - 5) WATTS; A Watts Water Technologies Company.
 - 6) Wade; a subsidiary of McWane Inc.
 - 7) Zurn Industries, LLC.
 - b. Basis of Design: Josam 22082.
 - c. Standard: ASME A112.6.4.
 - d. Body Material: Cast iron.
 - e. Dimension of Body: Nominal 14-to 16-inch diameter.
 - f. Dome Material: Cast iron.
 - g. Combination flashing ring and gravel stop.
 - h. Outlet: Side.
 - i. Outlet Type: type to match drainage piping.
 - j. Accessories:
 - 1) Flow-control weirs.

- 2) Extension collars.
- 3) Underdeck clamp.
- 4) Expansion joint.
- 5) Sump receiver plate.
- 6) Perforated Gravel Guard: Stainless steel.
- 7) Vandal-proof dome.
- 8) Water Dam: 2 inches high.

2.2 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Metal Downspout Nozzles: **RD-3**.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. WATTS; A Watts Water Technologies Company.
 - c. Wade; a subsidiary of McWane Inc.
 - d. Zurn Industries, LLC.
 - e. Josam Company.
2. Description: Nozzle with wall flange and mounting holes to cover rough opening and serve as anchor.
3. Size: Same as connected downspout.
4. Material: Cast bronze or nickel bronze nozzle and flange.
5. Piping Connection Type: type to match drainage piping.
6. Finish: Polished bronze.
7. Opening Protection: Birdscreen.

2.3 CLEANOUTS

A. Cast-Iron Cleanouts:

1. Cast-Iron Exposed Cleanouts.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Jay R. Smith Mfg Co; a division of Morris Group International.
 - 2) MIFAB, Inc.
 - 3) WATTS; A Watts Water Technologies Company.
 - 4) Wade; a subsidiary of McWane Inc.
 - 5) Zurn Industries, LLC.
 - 6) Josam Company.
 - b. Standard: ASME A112.36.2M.
 - c. Size: Same as connected branch.
 - d. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or No-hub, cast-iron soil pipe test tee as required to match connected piping.
 - e. Closure: Countersunk brass plug.
 - f. Closure Plug Size: Same as, or not more than, one size smaller than cleanout size.
2. Cast-Iron Exposed Floor Cleanouts
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Jay R. Smith Mfg Co; a division of Morris Group International.
 - 2) Sioux Chief Manufacturing Company, Inc.
 - 3) WATTS; A Watts Water Technologies Company.
 - 4) Wade; a subsidiary of McWane Inc.

- 5) Zurn Industries, LLC.
 - b. Standard: ASME A112.36.2M.
 - c. Size: Same as connected branch.
 - d. Type: Cast-iron soil pipe with cast-iron ferrule, Heavy-duty, adjustable housing.
 - e. Body or Ferrule: Cast iron.
 - f. Outlet Connection: as required to connect to adjacent piping.
 - g. Closure: Brass plug with straight threads and gasket.
 - h. Adjustable Housing Material: Cast iron with threads.
 - i. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
 - j. Frame and Cover Shape: Round.
 - k. Top Loading Classification: Extra-Heavy Duty.
 - l. Riser: ASTM A74, Extra-Heavy Class, cast-iron drainage pipe fitting and riser to cleanout.
 - m. Options:
 - 1) Clamping device.
3. Cast-Iron Wall Cleanouts.
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Jay R. Smith Mfg Co; a division of Morris Group International.
 - 2) MIFAB, Inc.
 - 3) WATTS; A Watts Water Technologies Company.
 - 4) Wade; a subsidiary of McWane Inc.
 - 5) Zurn Industries, LLC.

- 6) Josam Company.
 - b. Standard: ASME A112.36.2M. Include wall access.
 - c. Size: Same as connected drainage piping.
 - d. Body: Hub-and-spigot, cast-iron soil pipe T-branch or No-hub, cast-iron soil pipe test tee as required to match connected piping.
 - e. Closure Plug:
 - 1) Material: Cast iron.
 - 2) Head: Countersunk.
 - 3) Drilled and threaded for cover attachment screw.
 - 4) Size: Same as, or not more than, one size smaller than cleanout size.
 - f. Wall-Access Cover Plate: Round, flat, chrome-plated brass or stainless steel cover plate with screw.
 - g. Wall-Access Frame and Cover: Round, nickel-bronze, copper-alloy, or stainless steel wall-installation frame and cover.
4. Cast-Iron Test Tees
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Jay R. Smith Mfg Co; a division of Morris Group International.
 - 2) MIFAB, Inc.
 - 3) WATTS; A Watts Water Technologies Company.
 - 4) Zurn Industries, LLC.
 - 5) Josam Company.
 - b. Standard: ASME A112.36.2M and ASTM A74, ASTM A888, or CISPI 301.
 - c. Size: Same as connected drainage piping.

- d. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or no-hub, cast-iron soil-pipe test tee as required to match connected piping.
- e. Closure Plug: Countersunk, brass.
- f. Closure Plug Size: Same as, or not more than, one size smaller than cleanout size.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install roof drains in accordance with roof membrane manufacturer's written installation instructions at low points of roof areas.
 - 1. Install flashing collar or flange of roof drain to maintain integrity of waterproof membranes where penetrated.
 - 2. Install expansion joints, if indicated, in roof drain outlets.
 - 3. Position roof drains for easy access and maintenance.
- B. Install downspout nozzles at exposed bottom of conductors where they spill onto grade.
- C. Install cleanouts in aboveground piping and building drain piping in accordance with the following instructions unless otherwise indicated:
 - 1. Use cleanouts the same size as drainage piping up to 4 inch. Use 4 inch for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
 - 3. Locate cleanouts at minimum intervals of 50 ft. for piping 4 inch and smaller and 100 ft. for larger piping.
 - 4. Locate cleanouts at base of each vertical storm piping conductor.
- D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- F. Install test tees in vertical conductors and near floor.

G. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 221414 "Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 INSTALLATION OF FLASHING

A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

3.4 CLEANING

A. Clean piping specialties during installation and remove dirt and debris as work progresses.

3.5 PROTECTION

A. Protect piping specialties during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at end of each day and when work stops.

END OF SECTION 22 14 23

SECTION 22 14 29 - SUMP PUMPS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Condensate pumps. Type J

1.2 ACTION SUBMITTALS

A. Product Data:

1. Condensate Pumps

B. Product Data Submittals: For each product.

1. Construction details, material descriptions, dimensions of individual components and profiles.
2. Rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps and controls.

1. Indicate actual installed items by marking submittals with an arrow or box.

1.4 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 manufacturer's written instructions for handling.

1.5 WARRANTY

A. Manufacturer Warranty: Manufacturer and Installer agree to repair or replace sump pumps that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

- a. Faulty operation of pump, float mechanism and controls.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal use.
2. Warranty Period: 1 year(s) from date of Substantial Completion.

PART 2 PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of sump pump from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.
- B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

2.3 CONDENSATE SUMP PUMP – TYPE J

- A. Provide Little Giant Pump Company Model VCM-15ULS or approved equal.
- B. Unit shall be a vertical type-pumping unit, with high impact polystyrene tank, ABS motor, tank covers, volute and impeller.
- C. Duty: As scheduled on the drawings.
- D. Float switch.
- E. Thermally protected motor and stainless steel shaft.
- F. Equip with snap action switch, 6-foot long cord with 120 volt plug and safety switch.
- G. Provide a check valve with 3/8-inch outside diameter discharge.

2.3 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220500 "Common Work Results for Plumbing."
 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. Motors for submersible pumps are to be hermetically sealed.

PART 3 EXECUTION

3.1 EARTHWORK

- A. Excavation and filling are specified in Section 22 0500 "Common Work Results for Plumbing."

3.2 EXAMINATION

- A. Examine roughing-in for plumbing piping to verify actual locations of storm drainage piping connections before sump-pump installation.

3.3 INSTALLATION

- A. Pump Installation Standards: Comply with HI 14.4 for installation of sump pumps.
- B. Equipment Mounting:
 - 1. Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."
- C. Wiring Method: Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.4 PIPING CONNECTIONS

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to equipment, allow space for service and maintenance.

3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks in accordance with manufacturer's written instructions.

3.6 ADJUSTING

- A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust control set points.

3.7 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test, inspect, and adjust components, assemblies, and equipment installations, including connections.
- B. Tests and inspections:
 - 1. Perform each visual and mechanical inspection.
 - 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 motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 5. Pumps and controls will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 22 14 29

SECTION 22 33 00 - ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Commercial, light-duty, storage, electric, domestic-water heaters.
2. Domestic-water heater accessories.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Commercial, light-duty, storage, electric, domestic-water heaters.
2. Domestic-water heater accessories.

B. Product Data Submittals: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

C. Shop Drawings:

1. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of commercial, electric, domestic-water heater.

B. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

C. Source quality-control reports.

D. Field quality-control reports.

E. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For electric, domestic-water heaters to include emergency, operation, and maintenance manuals.

1.5 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - 2. Warranty Periods: From date of Substantial Completion.
 - a. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:
 - 1) Storage Tank: Five years Non-Prorated
 - 2) Controls and Other Components: One Year
 - b. Expansion Tanks: Five years.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.
- B. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.
- C. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

2.2 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

A. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A. O. Smith Corporation.
 - b. Bradford White Corporation.
 - c. Hubbell Water Heaters
 - d. State Industries.
2. Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.
3. Standard: UL 174.
4. Storage-Tank Construction: Steel, vertical arrangement.
 - a. Tappings: ASME B1.20.1 pipe thread.
 - b. Pressure Rating: 150 psig.
 - c. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending lining material into tappings.
5. Factory-Installed, Storage-Tank Appurtenances:
 - a. Dip Tube: Required unless cold-water inlet is near bottom of tank.
 - b. Drain Valve: Corrosion-resistant metal with hose-end connection.
 - c. Insulation: Comply with ASHRAE/IES 90.1.
 - d. Jacket: Steel with enameled finish or high-impact composite material.
 - e. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
 - f. Heating Elements: Electric, screw-in immersion type.

- g. Temperature Control: Adjustable thermostat.
- h. Safety Control: High-temperature-limit cutoff device or system.
- i. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valve with sensing element that extends into storage tank.

B. Capacity and Characteristics, are included on the drawings.

2.3 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A. O. Smith Corporation.
 - b. AMTROL, Inc.
 - c. Pentair Aurora; Pentair Pump Group.
 - d. ProFlo; a Ferguson Enterprises, Inc. brand.
 - e. State Industries.
 - f. Taco Comfort Solutions.
2. Source Limitations: Obtain domestic-water expansion tanks from single source from single manufacturer.
3. Description: Steel pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
4. 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 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-Charging Valve: Factory installed.
- 5. Capacity and Characteristics are included in the drawings.
- B. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than 3/4 inch with ASME B1.20.1 pipe threads.
- C. Piping-Type Heat Traps: Field-fabricated piping arrangement in accordance with ASHRAE/IES 90.1.
- D. Heat-Trap Fittings: ASHRAE/IES 90.1.
- E. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valves with sensing element that extends into storage tank.
- F. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than working-pressure rating of domestic-water heater.
- G. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.
- H. Equipment Pad: see specification section 22 05 00 Common Work Results for Plumbing.

2.4 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, in accordance with ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.
- C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 3 EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in 22 05 00 Common Work Results for Plumbing".
1. Maintain manufacturer's recommended clearances.
 2. Arrange units so controls and devices that require servicing are accessible.
 3. 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.
 4. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 5. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 6. Install anchor bolts to elevations required for proper attachment to supported equipment.
 7. Anchor domestic-water heaters to substrate.
- B. Install electric, domestic-water heaters level and plumb, in accordance with 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 221116 "Domestic Water Piping."
- C. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend domestic-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.
- D. 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 electric, domestic-water heaters that do not have tank drains. Comply with

requirements for hose-end drain valves specified in Section 221116 "Domestic Water Piping."

- E. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220500 "Common Work Results for Plumbing."
- F. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.
- G. Fill electric, domestic-water heaters with water.
- H. Charge domestic-water expansion tanks with air to required system pressure.
- I. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water to contain less than 0.25 percent of lead by weight.

3.2 PIPING CONNECTIONS

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to electric, 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. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. 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 operation.

- 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain domestic-water heaters. Training to be a minimum of one hour(s).

END OF SECTION 22 33 00

SECTION 22 42 00 - COMMERCIAL PLUMBING FIXTURES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Commercial lavatories.
2. Commercial sinks.
3. Commercial water closets.
4. Flushometer valves.
5. Toilet seats.
6. Fixture carriers.

1.2 DEFINITIONS

- A. Standard-Efficiency Flush Volume: 1.6 gal. per flush.
- B. High-Efficiency Flush Volume: 1.28 gal. or less per flush.
- C. WaterSense Fixture: Water closet and/or flushometer valve/tank certified by the EPA to meet the WaterSense performance criteria.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for plumbing fixtures.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. For lavatories and faucets.
 - a. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1) Servicing and adjustments of automatic faucets.
2. For sinks and faucets to include in operation and maintenance manuals.
 - a. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1) Servicing and adjustments of automatic faucets.
3. For flushometer valves and electronic sensors to include in operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Faucet Washers and O-Rings: Equal to 2 of each type and size installed.
 2. Flushometer-Valve Repair Kits: Equal to 2 of each type.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Lavatory faucets, sink faucets, shower valves, and wash fountain spray heads and faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- 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.

2.2 COMMERCIAL LAVATORIES

A. Lavatories, Wall Mounted:

1. Lavatories, Wall Mounted - Vitreous China, Rectangular with Back: **P-2**
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) American Standard.
 - 2) Gerber Plumbing Fixtures LLC.
 - 3) Kohler Co.
 - 4) Sloan Valve Company.
 - 5) Zurn Industries, LLC.
 - b. Basis of Design: American Standard Lucerne Model 0355.056.
 - c. Fixture:
 - 1) Standard: ASME A112.19.2/CSA B45.1.
 - 2) Type: For wall hanging.
 - 3) Nominal Size: Rectangular, 18 by 16 inches.
 - 4) Faucet-Hole Punching: Three holes, 4-inch centers.
 - 5) Faucet-Hole Location: Top.
 - 6) Color: White.
 - 7) Mounting Material: Chair carrier.
 - d. Faucet: **F-1**.
 - e. Support: Concealed arm.
 - f. Lavatory Mounting Height: Accessible in accordance with ICC A117.1.

B. Lavatory Faucets, Automatically Operated: **F-1**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard.
 - b. Bradley Corporation.
 - c. Chicago Faucets; Geberit Group.
 - d. Delta Faucet Company.
 - e. Elkay.
 - f. Just Manufacturing.
 - g. Kohler Co.
 - h. Moen Incorporated.
 - i. Sloan Valve Company.
 - j. Speakman Company.
 - k. T&S Brass and Bronze Works, Inc.
 - l. TOTO USA, INC.
 - m. Zurn Industries, LLC.
2. Standards: ASME A112.18.1/CSA B125.1 and UL 1951.
3. Operation Type: Battery powered electronic sensor operated, mixing.
4. 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. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
6. Body Type: Single hole.
7. Body Material: Commercial, solid-brass, or die-cast housing with brazed copper and brass waterway.
8. Finish: Polished chrome plate.
9. Maximum Flow Rate: 0.5 gpm.
10. Mounting Type: Deck, concealed.
11. Spout: Rigid type.
12. Spout Outlet: Aerator.
13. Drain: Not part of faucet.

C. Lavatory Supply Fittings:

1. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.
2. Standard: ASME A112.18.1/CSA B125.1.
3. 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.

4. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
5. Operation: Wheel handle.
6. Risers:
 - a. ½ inch.
 - b. ASME A112.18.6/CSA B125.6, braided or corrugated stainless steel, flexible hose riser.

D. Lavatory Waste Fittings:

1. Standard: ASME A112.18.2/CSA B125.2.
2. Drain: Grid type with 1-1/4 inch offset and straight tailpiece.
3. Trap:
 - a. Size: 1-1/2 by 1-1/4 inch.
 - b. Material:
 - 1) Chrome-plated, one-piece, cast-brass trap with swivel 0.029-inch-thick tubular brass wall bend; and chrome-plated, brass or steel wall flange.

2.3 COMMERCIAL SINKS

A. Service Sinks, Floor Mounted:

1. Service Sinks, Floor Mounted - Terrazzo: **P-3**
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Acorn Engineering Company; a Division of Morris Group International.
 - 2) Fiat Products.
 - 3) Florestone Products Co., Inc.
 - 4) Stern-Williams Products, LLC.

- b. Basis of Design: Fiat Model TSB3001.
 - c. Source Limitations: Obtain sinks from single source from single manufacturer.
 - d. Fixture:
 - 1) Material: Marble chips cast in portland cement to produce a compressive strength of not less than 3000 psi (20.7 MPa), seven days after casting.
 - 2) Shape: Square.
 - 3) Nominal Size: 32 by 32 inches.
 - 4) Height: 12 inches with dropped front.
 - 5) Tiling Flange: Not required.
 - 6) Rim Guard: On front top surfaces.
 - 7) Color: Not applicable.
 - 8) Drain: Grid with 3 inch outlet.
 - e. Mounting: On floor and flush to wall.
 - f. Faucet: **F-2**
2. Sink Faucets, Manually Operated - Service Sink: **F-2**
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Acorn Engineering Company; a Division of Morris Group International.
 - 2) Central Brass Company; a Pioneer Industries, Inc. brand.
 - 3) Chicago Faucets; Geberit Group.
 - 4) Fiat Products.
 - 5) Just Manufacturing.

- 6) Kohler Co.
- 7) Speakman Company.
- 8) Stern-Williams Products, LLC.
- 9) T&S Brass and Bronze Works, Inc.
- 10) Zurn Industries, LLC.
- b. Basis of Design: Fiat Model 830-AA
- c. Source Limitations: Obtain sink faucets from single source from single manufacturer.
- d. Description: Wall/back mounted, brass body, with integral service stops, checks, spout with bucket/pail hook, 3/4-inch hose thread end, integral vacuum breaker, inlets 8 inches o.c., and two-handle mixing.
- e. Faucet:
 - 1) Standards:
 - a) ASME A112.18.1/CSA B125.1.
 - b) NSF 61 and NSF 372.
 - c) ICC A117.1.
 - d) ASSE 1001 (VB).
 - 2) Finish: Rough chrome plated.
 - 3) Handles: four arms.
 - 4) Cartridges: One-fourth turn compression.
 - 5) Brace: Adjustable top brace.
- f. Vacuum Breaker: Required for hose outlet.
- g. Spout Outlet: Hose thread in accordance with ASME B1.20.7.

B. Sink Supply Fittings:

1. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.
2. Standard: ASME A112.18.1/CSA B125.1.
3. 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.
4. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
5. Operation: Wheel handle.

C. Grout:

1. Standard: ASTM C1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
2. Characteristics: Nonshrink; recommended for interior and exterior applications.
3. Design Mix: 5000 psi, 28-day compressive strength.
4. Packaging: Premixed and factory packaged.

2.4 COMMERCIAL WATER CLOSETS

A. Water Closets, Wall Mounted:

1. Water Closets, Wall Mounted - Top Spud: **P-1**
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) American Standard.
 - 2) Gerber Plumbing Fixtures LLC.
 - 3) Kohler Co.
 - 4) Sloan Valve Company.
 - 5) TOTO USA, INC.
 - 6) Zurn Industries, LLC.

- 7) Acorn Engineering Company; a Division of Morris Group International.
- b. Basis of Design: American Standard Aftwall Millenium FloWise 3351.101
- c. Source Limitations: Obtain water closets from single source from single manufacturer.
- d. Standard: ASME A112.19.2/CSA B45.1.
- e. Bowl:
 - 1) Material: Vitreous china.
 - 2) Type: Siphon jet.
 - 3) Style: Flushometer valve.
 - 4) Mounting Height: Accessible in accordance with ICC A117.1.
 - 5) Rim Contour: Elongated.
 - 6) Water Consumption: 1.28 gal. per flush.
 - 7) Spud Size and Location: 1-1/2 inch; top.
 - 8) Color: White.
- f. Flushometer Valve: **FV-1**
- g. Toilet Seat: **TS-1**.
- h. Support: Water-closet carrier, wall affixed.

2.5 FLUSHOMETER VALVES

A. Flushometer Valves, Manually Operated:

- 1. Flushometer Valves, Sensor Operated - Diaphragm: **FV-1**
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Advanced Modern Technologies Corporation - AMTC.
 - 2) Delany Products.
 - 3) I-Con Systems, Inc.

- 4) Sloan Valve Company.
- 5) Zurn Industries, LLC.
- b. Source Limitations: Obtain flushometer valve from single source from single manufacturer.
- c. Standard: ASSE 1037/ASME 112.1037/CSA B125.37.
- d. Minimum Pressure Rating: 125 psig.
- e. Features: Include integral check stop and backflow-prevention device.
- f. Material: Brass body with corrosion-resistant components.
- g. Style: Exposed.
- h. Exposed Flushometer-Valve Finish: Chrome-plated.
- i. Actuator: Side or top mounted; listed and labeled as defined in NFPA 70, by qualified testing agency, and marked for intended location and application.
- j. Trip Mechanism: Battery-powered electronic sensor; listed and labeled as defined in NFPA 70, by qualified testing agency, and marked for intended location and application.
- k. Consumption: 1.28 gal. per flush.
- l. Minimum Inlet: 1 inch.
- m. Minimum Outlet: 1-1/4 inch.

2.6 TOILET SEATS

A. Toilet Seats: **TS-1**

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard.
 - b. Bemis Manufacturing Company.
 - c. Church Seats; Bemis Manufacturing Company.
 - d. Kohler Co.
 - e. TOTO USA, INC.
 - f. Zurn Industries, LLC.
- 2. Source Limitations: Obtain toilet seat from single source from single manufacturer.
- 3. Standard: IAPMO/ANSI Z124.5.
- 4. Material: Plastic.

5. Type: Commercial (Heavy duty).
6. Shape: Elongated rim, open front.
7. Hinge: Check.
8. Hinge Material: Noncorroding metal.
9. Seat Cover: Not required.
10. Color: White.
11. Surface Treatment: Not required.

2.7 FIXTURE CARRIERS

A. Fixture Carriers - Lavatory:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. WATTS; A Watts Water Technologies Company.
 - e. Zurn Industries, LLC.
2. Source Limitations: Obtain lavatory carriers from single source from single manufacturer.
3. Standards:
 - a. ASME A112.6.1M.
 - b. ASME A112.6.2.

B. Fixture Carriers - Water Closet:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. WATTS; A Watts Water Technologies Company.
 - e. Zurn Industries, LLC.
2. Source Limitations: Obtain water closet carriers from single source from single manufacturer.
 3. Standard: ASME A112.6.1M.
 4. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings, gaskets, and feet; bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water-supply piping and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine walls and floors for suitable conditions where plumbing fixtures will be installed.
- C. Examine counters for suitable conditions where lavatories and sinks will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF COMMERCIAL PLUMBING FIXTURES

A. Lavatory Installation:

1. Install lavatories level and plumb in accordance with roughing-in drawings.
2. Install supports, affixed to building substrate, for wall-mounted lavatories.
3. Install accessible, wall-mounted lavatories at mounting height in accordance with ICC A117.1.

4. Install water-supply piping with stop on each supply to each lavatory faucet. Install stops in locations that are accessible for ease of operation.
5. Install trap and waste piping on each drain outlet of each lavatory to be connected to sanitary drainage system.
6. 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 220500 "Common Work Results for Plumbing."
7. Seal joints between lavatories, counters, 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."
8. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

B. Sink Installation:

1. Install sinks level and plumb in accordance with roughing-in drawings.
2. Set floor-mounted sinks in leveling bed of cement grout.
3. Install water-supply piping with stop on each supply to each sink faucet.
 - a. Exception: Use ball or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523 "General Duty Valves for Plumbing Piping."
 - b. Install stops/valves in locations that are accessible for ease of operation.
4. Install trap and waste piping on each drain outlet of each sink to be connected to sanitary drainage system.
5. 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 220500 "Common Work Results for Plumbing."
6. Seal joints between sinks, 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."

7. 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."

C. Water Closet Installation:

1. Install water closets level and plumb in accordance with roughing-in drawings.
2. Install accessible, wall-mounted water closets at mounting height in accordance with ICC A117.1.
3. Use carrier supports with waste-fitting assembly and seal.
4. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals, and affix to building substrate.
5. Measure support height installation from finished floor, not structural floor.
6. Install flushometer-valve, water-supply fitting on each supply to each water closet.
7. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
8. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
9. Install actuators in locations easily reachable for people with disabilities.
10. Install toilet seats on water closets.
11. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Install deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."
12. Seal joints between water closets, walls, and floors using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to water-closet color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 INSTALLATION OF PIPING CONNECTIONS

- A. Connect plumbing fixtures with water supplies and soil, waste, and vent piping. Use size fittings required to match plumbing fixtures.

- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil, waste, and vent piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Install protective-shielding pipe covers and enclosures on exposed supplies and waste piping of accessible plumbing fixtures. Comply with requirements in Section 220719 "Plumbing Piping Insulation."
- E. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.4 INSTALLATION OF CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

3.5 ADJUSTING

- A. Operate and adjust plumbing fixtures and controls. Replace damaged and malfunctioning plumbing fixtures, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.
- C. Adjust water pressure at flushometer valves to produce proper flow.

3.6 CLEANING AND PROTECTION

- A. After completing installation of plumbing fixtures, inspect and repair damages finishes. Replace any fixtures unable to be repaired to the satisfaction of the Owner.
- B. Clean plumbing fixtures and associated faucets, valves, flushometer valves, and fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed plumbing fixtures and associated faucets, valves, flushometer valves, and fittings.
- D. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 42 00

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SECTION 22 47 00 - DRINKING FOUNTAINS AND WATER COOLERS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Water coolers.
2. Fixture carriers.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.
 - a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - b. Include operating characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include details of fixture assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power wiring.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For water coolers to include in maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include servicing and adjustment of electronic-sensor fixtures.

1.4 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. Filter Cartridges: No fewer than one of each type and size indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's written instructions for delivery, storage, and handling.

1.6 WARRANTY

- A. Manufacturer Warranty: Manufacturer and Installer agree to repair or replace water coolers [bottle filling stations that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

- a. Faulty operation of compressor and controls.
- b. Deterioration of metals, metal finishes, and other materials beyond normal use.

- B. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Standards:

1. Drinking fountains, water coolers, bottle filling stations, and remote water coolers intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), requirements of the authority having jurisdiction, and with NSF 61 or NSF 372, or be certified in compliance with NSF 61 or NSF 372 by an ANSI-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 WATER COOLERS

- A. Water Coolers - Surface Wall Mounted, Vinyl-Covered Metal with Stainless Steel Top:
P-5

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkay.

- b. Halsey Taylor.
- 2. Basis of Design: Halsey Taylor Model HTHB-HAC8BLPV-NF
- 3. Source Limitations: Obtain surface wall-mounted, vinyl-covered metal water coolers with stainless steel top from single source from single manufacturer.
- 4. Standards:
 - a. NSF 61.
 - b. NSF 372.
 - c. ASME A112.19.3/CSA B45.4.
 - d. ASHRAE 18.
 - e. UL 399.
 - f. 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. Type: Vandal resistant.
- 6. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
- 7. Control: Push bar.
- 8. Bottle Filler: Sensor, with 20-second automatic shutoff timer: Fill rate is 0.5 to 1.5 gpm.
- 9. Drain: Grid with 1-1/4 inch tailpiece.
- 10. Supply: 3/8 inch with shutoff valve.
- 11. Waste Fitting: ASME A112.18.2/CSA B125.2, 1-1/4 inch brass P-trap.
- 12. Filter: One or more water filters with capacity sized for unit peak flow rate.
 - a. Standards:
 - 1) NSF 42.
 - 2) NSF 53.

13. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
14. Support: Fixture carrier.
15. Water-Cooler Mounting Height: High/low - standard/accessible in accordance with ICC A117.1.
16. Capacities and Characteristics:
 - a. Cooled Water: 8 gph.
 - b. Ambient-Air Temperature: 90 deg F.
 - c. Inlet-Water Temperature: 80 deg F.
 - d. Cooled-Water Temperature: 50 deg F.
 - e. Electrical Characteristics:
 - 1) Volts: 120 V ac.
 - 2) Phase: Single.
 - 3) Hertz: 60 Hz.

2.3 FIXTURE CARRIERS

A. Fixture Carriers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. WATTS; A Watts Water Technologies Company.
 - e. Wade; a subsidiary of McWane Inc.
 - f. Zurn Industries, LLC.

2. Standard: ASME A112.6.1M.

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 in accordance with roughing-in drawings. For fixtures indicated for juveniles, install at height required by authorities having jurisdiction.
- B. Set freestanding water coolers on floor.
- C. Install recessed drinking fountains and bottle filling stations secured to wood blocking in wall construction.
- D. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
- E. Install mounting frames, affixed to building construction, and attach recessed water coolers and bottle filling stations to mounting frames.
- F. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- G. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- H. 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 220500 "Common Work Results for Plumbing."
- I. 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."

3.3 PIPING 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 shutoff valve on water supply to each fixture. Comply with valve requirements specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

3.5 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust water cooler temperature settings.
- C. Adjust electronic-sensor settings.

3.6 CLEANING

- A. After installing fixtures, 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, in accordance with 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 22 47 00

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SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Motors.
2. Sleeves without waterstop.
3. Sleeves with waterstop.
4. Stack-sleeve fittings.
5. Grout.
6. Silicone sealants.
7. Escutcheons.
8. Thermometers, liquid in glass.
9. Duct-thermometer mounting brackets.
10. Contractor coordination.
11. Site examination.
12. Permits
13. Work in existing buildings.
14. Cleaning of systems.
15. Excavation and backfill.

1.2 DEFINITIONS

- A. “Approve”** - To permit use of material, equipment or methods conditional upon compliance with contract document requirements.
- B. “Concealed”** - Hidden from normal sight; includes work in crawl spaces, above ceilings, and in building shafts.

- C. “Directed” - Directed by Engineer.
- D. “Equal, equivalent” - Possessing the same performance qualities and characteristics and fulfilling the same utilitarian function.
- E. “Existing Piping to Remain” - Existing piping that is not to be removed and that is not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- F. “Exposed” - Not concealed.
- G. “Furnish” - Supply and deliver to project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- H. “Indicated” - Indicated in Contract Documents.
- I. “Install” - Operations at project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimensions, finishing, curing, protecting, cleaning and similar operations.
- J. “Piping” - Includes pipe, fittings, valves, supports and accessories comprising a system.
- K. “Provide” - Furnish and install, complete and ready for the intended use.
- L. “Removable” - Detachable from the structure or system without physical alteration of materials or equipment and without disturbance to other construction.
- M. “Review” - Limited observation or checking to ascertain general conformance with design concept of the work and with information given in contract documents. Such action does not constitute a waiver or alteration of the contract requirements.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. For each type of product, excluding motors which are included in Part 1 of HVAC equipment Sections.
 - a. Include construction details, material descriptions, and dimensions of individual components, and finishes.
 - b. Include operating characteristics and furnished accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

- B. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1.
- B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators in accordance with 2021 ASME Boiler and Pressure Vessel Code, Section IX.
- C. Contract drawings for mechanical work are diagrammatic, intended to convey scope and general arrangement.
- D. Refer questions involving document interpretation or discrepancies to Engineer for review and direction.
- E. Correct faulty work due to resolving discrepancies without proper approval.
- F. Specifications establish quality of materials, equipment, workmanship and methods of construction.
- G. Follow drawings and specifications in laying out work. Consult other applicable contract drawings and specifications, become familiar with conditions affecting work.
- H. Regulations: Comply with regulations of NFPA, state, county, and municipal building ordinances, and other applicable codes and regulations.
- I. Provide UL label on electric powered equipment or certification that equipment has been tested by a testing agency approved by the local authority as equivalent in safety to UL labeled equipment.
- J. Material and Equipment Requirements
 - 1. Use products of one manufacturer where two or more items of same kind of equipment are required.
 - 2. Materials and equipment shall have a record of one-year successful field use.
 - 3. For certain items of equipment, the specification and the project design are based upon the specified manufacturer's product. Other manufacturers' names are listed. Contractor may purchase, conditional upon meeting project requirements, equipment from the listed manufacturers.
 - 4. Only the manufacturer's equipment upon which the specification and the project design has been based, has been checked for this project. Check allocated space

and structure for suitability of equipment of other listed manufacturers, including parts replacement and servicing.

5. Basis of Design Products: Where the Specifications or Drawings name a specific manufacturer's product accompanied by the words "Basis of Design," including make or model number or other designation, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Naming of a Basis of Design product is intended 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. The drawings indicate the general size, configuration, location, connections and/or support for equipment or systems specified with relation to the other building systems.

K. Workmanship

1. Remove and replace, at no extra cost, work not in conformance with contract requirements.
2. Coordinate work and cooperate with other trades to facilitate execution of work.

L. Coordination with Other Trades

1. Contractor shall give full cooperation and coordination with other trades and shall furnish any information necessary to permit the work of all trades to be installed satisfactorily with the least possible interference or delay.
2. The Contractor shall furnish to other trades, as required, all necessary templates, patterns, setting plans and shop details for the proper installation of the work and for the purpose of coordination adjacent work.

- M. Asbestos or asbestos-containing materials shall not be utilized or allowed on this project. The Contractor shall be rigorous in ensuring that all materials, equipment, systems, and components do not contain asbestos. Any deviations from this exclusion shall be remedied at the Contractor's expense without regard to prior submittal approvals.

- N. Access: The Contractor shall specifically consider all materials and equipment installations and shall coordinate with the work of all trades to ensure easy and unobstructed accessibility of all systems for operations, maintenance, repairs, and replacement. Installation of all specified materials and equipment including but not limited to, equipment, supports, pipe, electrical conduit and controls shall be in a manner which will allow complete unobstructed access to all panels, access doors, filter

racks, control boxes, controls actuators, sensors, valves, and all other items requiring access for operations or maintenance. All items such as controls, actuators and valves which require servicing or manual operations for system use shall be located such as to be accessible without standing on other equipment, whenever it is possible or practical. Any installation of new equipment or materials which causes problems related to access of new or existing equipment shall be disapproved by the Engineer and re-accomplished by the Contractor.

1.6 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.
- B. References
 - 1. References to standards, codes, catalogs and recommendations are latest edition in effect on date of invitation to bid.
 - 2. Refer to applicable contract drawings and specifications pertaining to other Divisions for conditions affecting work.
 - 3. Refer to Division 01 for description of alternates.
 - 4. Refer to Division 01 for description of base bid items.

PART 2 PRODUCTS

2.1 CONCRETE WORK

- A. Compressive Strength: 3000-psi minimum after 28 days.
- B. Reinforcing Steel: Yield strength as determined by structural design.
- C. Grout: Non-shrink, non-metallic, pre-mixed, equivalent to Nordbak Fast-set, U.S. Grout Five-star, or Polymeric.

2.2 MOTORS

A. Motor Requirements, General:

1. Content includes motors for use on alternating-current power systems of up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
2. Comply with requirements in this Section except when stricter requirements are specified in equipment schedules or Sections.
3. Comply with NEMA MG 1 unless otherwise indicated.

B. Motor Characteristics:

1. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 ft. above sea level.
2. 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. Single-Phase Motors:

1. Motors larger than 1/20 hp must be one of the following, to suit starting torque and requirements of specific motor application:
 - a. Permanent-split capacitor.
 - b. Split phase.
 - c. Capacitor start, inductor run.
 - d. Capacitor start, capacitor run.
2. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
3. Motors 1/20 hp and Smaller: Shaded-pole type.
4. 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 will automatically reset when motor temperature returns to normal range.

D. Electronically Commutated Motors:

1. Microprocessor-Based Electronic Control Module: Converts 120 V or 240 V single-phase AC power to three-phase DC power to operate the brushless DC motor.
2. Three-phase power motor module with permanent magnet rotor.
3. Circuit board or digital speed controller/LED display.
4. Building Automation System Interface: Via AC voltage signal, DC voltage signal, or Digital Serial Interface (DSI).

2.3 SLEEVES AND SLEEVE SEALS

A. Sleeves without Waterstop:

1. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron, with plain ends.
2. Steel Pipe Sleeves: ASTM A53, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.
3. Steel Sheet Sleeves: ASTM A653, 24 gauge minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.

B. Sleeves with Waterstop:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, LLC.
 - b. CALPICO, Inc.
 - c. GPT; a division of EnPRO Industries.
 - d. Metraflex Company (The).
2. Description: Manufactured galvanized-steel, sleeve-type, waterstop assembly, made for imbedding in concrete slab or wall.

C. Stack-Sleeve Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. Wade; a subsidiary of McWane Inc.
 - c. Zurn Industries, LLC.
 - 2. Description: Manufactured, galvanized cast-iron sleeve with integral cast flashing flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.
 - a. Underdeck Clamp: Clamping ring with setscrews.
- D. Grout:
- 1. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
 - 2. Standard: ASTM C1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
 - 3. Design Mix: 5000 psi, 28-day compressive strength.
 - 4. Packaging: Premixed and factory packaged.
- E. Silicone Sealants:
- 1. Silicone Sealant, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) GE Construction Sealants; Momentive Performance Materials Inc.
 - 2) ITW Polymers Sealants North America.
 - 3) Polymeric Systems, Inc.
 - 4) Sherwin-Williams Company (The).
 - 5) Sika Corporation.
 - 6) The Dow Chemical Company.

- 7) Tremco Incorporated.
 - b. Standard: ASTM C920, Type S, Grade NS, Class 25, Use NT.
- 2. Silicone Foam Sealant: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
 - a. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1) Smooth-On.

2.4 ESCUTCHEONS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. BrassCraft Manufacturing Co.; a Masco company.
 - 2. Dearborn Brass.
 - 3. Jones Stephens Corp.
 - 4. Keeney Manufacturing Company (The).
 - 5. Mid-America Fittings, LLC; A Midland Industries Company.
 - 6. ProFlo; a Ferguson Enterprises, Inc. brand.
- B. Escutcheon Types:
 - 1. One-Piece, Steel Type: With polished, chrome-plated or polished brass finish and setscrew fastener.
 - 2. One-Piece, Stainless Steel Type: With polished stainless steel finish.
 - 3. One-Piece, Cast-Brass Type: With polished, chrome-plated or polished brass finish and setscrew fastener.
 - 4. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel or brass with polished, chrome-plated finish and spring-clip fasteners.
 - 5. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.

6. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed and exposed-rivet hinge; and spring-clip fasteners.

C. Floor Plates:

1. Split Floor Plates: Steel with concealed hinge.

2.5 METERS AND GAUGES FOR HVAC PIPING

A. Thermometers, Liquid in Glass - Metal Case, Industrial Style:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Terice, H. O. Co.
 - b. Weiss Instruments, Inc.
 - c. Weksler Glass Thermometer Corp.
2. Source Limitations: Provide liquid-in-glass, metal-case, industrial-style thermometers from single manufacturer.
3. Standard: ASME B40.200.
4. Case: Cast aluminum; 4-1/2 inch nominal size unless otherwise indicated.
5. Case Form: Adjustable angle unless otherwise indicated.
6. Tube: Glass with magnifying lens and blue organic liquid.
7. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
8. Window: Glass.
9. Stem: Aluminum and of length to suit installation.
 - a. Design for Air-Duct Installation: With ventilated shroud.
 - b. Design for Thermowell Installation: Bare stem.
10. Connector: 1-1/4 inches, with ASME B1.1 screw threads.

11. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

B. Duct-Thermometer Mounting Brackets:

1. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

PART 3 EXECUTION

3.1 INSTALLATION OF SLEEVES - GENERAL

- 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 except as required for wet areas below.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 2. 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.
 3. Using grout or silicone sealant, seal space outside of sleeves in floors/slabs/walls without sleeve-seal system. Select to maintain fire resistance of floor/slab/wall.
- 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 that joint sealant manufacturer's literature indicates is appropriate for size, depth, and location of joint.

3.2 INSTALLATION OF SLEEVES WITH WATERSTOP

- A. Install sleeve with waterstop as new walls and slabs are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange centered across width of concrete slab or wall.
- C. Secure nailing flanges to wooden concrete forms.
- D. Using grout or silicone sealant, seal space around outside of sleeves.

3.3 INSTALLATION OF STACK-SLEEVE FITTINGS

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
 1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
 3. Install section of cast-iron soil pipe to extend sleeve to 3 inches above finished floor level.
 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 5. Using silicone sealant, seal space between top hub of stack-sleeve fitting and pipe.

3.4 INSTALLATION OF ESCUTCHEONS

- 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 insulated piping and with OD that completely covers opening.

3.5 INSTALLATION OF METERS AND GAUGES

- A. Install duct-thermometer-mounting brackets in walls of ducts. Attach to duct with screws.

B. Install thermometers in the following locations:

1. Outside-, return-, supply-, and mixed-air ducts.

3.12 INSTALLATION OF EQUIPMENT PADS

A. Concrete Equipment Pads

1. Provide concrete pads not less than 4 inches high and projecting not less than 3 inches on all sides beyond equipment for floor mounted equipment.
2. Place anchor bolts in steel pipe sleeves, with a plate at bottom end of sleeve to hold bolts.
3. Grout between base plate and foundation.

3.6 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gauges to proper angle for best visibility.

3.7 FIELD QUALITY CONTROL

A. Sleeves and Sleeve Seals:

1. Perform the following tests and inspections:
 - a. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
 - b. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
2. Prepare test and inspection reports.

B. Escutcheons:

1. Using new materials, replace broken and damaged escutcheons and floor plates.

3.8 SLEEVES APPLICATION

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above and below Grade:

- a. Sleeves with waterstops.
- 2. Concrete Slabs-on-Grade:
 - a. Sleeves with waterstops.
- 3. Concrete Slabs above Grade:
 - a. Sleeves with waterstops or stack-sleeve fittings.
- 4. Interior Walls and Partitions:
 - a. Sleeves without waterstops.

3.9 ESCUTCHEONS APPLICATION

A. Escutcheons for New Piping and Relocated Existing Piping:

- 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
- 2. Chrome-Plated Piping: One piece, steel, cast brass or split-plate **steel** with polished, chrome-plated finish.
- 3. Insulated Piping:
 - a. One piece, steel with polished, chrome-plated or polished brass finish to match adjacent finish.
- 4. Bare Piping at Wall and Floor Penetrations in Finished Spaces:
 - a. One piece, steel with polished, chrome-plated or polished brass finish to match adjacent finish.
- 5. Bare Piping at Ceiling Penetrations in Finished Spaces:
 - a. One piece, steel with polished, chrome-plated or polished brass finish to match adjacent finish.
- 6. Bare Piping in Unfinished Service Spaces:
 - a. One piece, steel with polished, chrome-plated finish.
- 7. Bare Piping in Equipment Rooms:
 - a. One piece, steel with polished, chrome-plated finish.

B. Escutcheons for Existing Piping to Remain:

1. Chrome-Plated Piping: Split casting, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
2. Insulated Piping: Split plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish
3. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
4. Bare Piping at Ceiling Penetrations in Finished Spaces: Split plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
5. Bare Piping in Unfinished Service Spaces: Split plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
6. Bare Piping in Equipment Rooms: Split plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.

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 and Relocated Existing Piping: Split floor plate.
2. Existing Piping to Remain: Split floor plate.

3.10 THERMOMETER APPLICATION

A. Thermometers at outside-, return-, supply-, and mixed-air ducts are to be the following:

1. Industrial-style, liquid-in-glass type.

3.11 THERMOMETER SCALE-RANGE APPLICATION

A. Scale Range for Air Ducts:

1. 0 to 150 deg F.

3.12 COORDINATION DRAWINGS

- A. Submit, prior to installation of mechanical systems, composite working drawings prepared in coordination with other trades at a scale not less than 1/2-inch = 1-foot, clearly showing how work is to be installed in relation to the work of all trades. Contractor shall assist in working out congested space conditions to make a satisfactory adjustment. Drawings shall show the work of all trades (ductwork, conduit, piping, plumbing, lights, equipment, sprinklers, electrical work, etc.) exposed and concealed, coordinated with each other and with the structure. Drawings shall be submitted and bear the Engineer review stamp before any materials are ordered or fabricated.
- B. Work installed before coordinating with other trades or as to cause any interference with work of other trades shall be changed by the Contractor to correct the conditions at their expense.
- C. Drawings shall show existing services where clearances for access are to be maintained.
- D. Relocate existing work or modify location of new work as required to maintain required access and code clearances.

3.13 SITE EXAMINATION

- A. Failure to visit site and become familiar with local conditions prior to bidding will not relieve the Contractor of their responsibility for complying with the Contract Documents.

3.14 PERMITS

- A. Obtain and pay for required permits.

3.15 WORK IN EXISTING BUILDINGS

- A. Alterations
 - 1. Cut, alter, remove or temporarily remove and replace existing work necessary for installation of mechanical and associated electrical work. Maintain the necessary clearances for accessibility or compliance with code around existing equipment, devices, etc., that are to remain.
 - 2. Verify dimensions of existing building elements pertaining to the installation of new work to ensure physical compatibility prior to fabrication or installation.
 - 3. Where the installation of new services or the extension of existing services requires cutting of existing floors, walls, partitions, etc., check for the presence of

existing fire suppression, plumbing, mechanical and electrical services within or immediately beneath construction and exercise necessary precautions to prevent damage to the service or injury to personnel due to contact with same. Where practical, temporarily disconnect such existing service during the cutting operation. Schedule such outages in service with the Owner, 14 days in advance.

3.16 PROTECTION

- A. Protect mechanical and associated electrical material and equipment from the elements or other injury as soon as delivered on premises. Protect mechanical fixtures as soon as they are set.
 - 1. Accept in original packaging.
 - 2. Store in clean, dry space.
 - 3. Protect from dirt, water, construction debris, and traffic.
 - 4. Handle in accordance with manufacturer's written instructions.
- B. Cap or plug openings in equipment, piping, and conduit systems, to exclude dirt and other foreign material. Do not use rags, wool, cotton, paper, waste or similar materials for plugging.
- C. Existing components of the building and its systems shall be protected from damage. Any damage to these components shall be repaired or replaced to the satisfaction of the Owner. Special care shall be taken with regards to insulation on existing piping and ductwork. Damaged insulation shall be replaced so that the vapor barrier and insulating characteristics of the material match those prior to damage taking place.

3.17 CLEANING OF SYSTEMS

- A. Thoroughly clean systems after satisfactory completion of pressure tests and before permanently connecting equipment, strainers, and other accessory items. Blow out and flush piping until interior are free of foreign matter.
- B. Leave strainers and dirt pockets in clean condition.
- C. Pay for labor and materials required to locate and remove obstructions from systems clogged with construction refuse after acceptance. Replace and repair work disturbed during removal of obstructions.
- D. Leave systems clean, and in complete running order.

3.18 EXCAVATION AND BACKFILL

- A. Excavate and backfill as required to install underground mechanical work.
- B. Establish required lines and grade.
- C. Excavate to sufficient depth to give 30-inch minimum cover, unless otherwise indicated.
- D. Keep excavation drained and pumped out.
- E. Remove excavated materials not required or suitable for backfill.
- F. Protection
 - 1. Protect existing utilities and underground work by shoring and bracing.
 - 2. Provide guardrail, lamps, flags, and other safeguards at temporary walk and road crossings.
 - 3. Provide shoring, sheet piling and bracing for protection of work and safety of personnel. Timber sheeting below top of pipe shall not be removed.
 - 4. Protect trees, structures, and other property from injury during work.
 - 5. Prevent debris and other materials from entering piping and drains.
- G. Trenching
 - 1. Excavate to depth and width required for proper installation of item to be buried with a minimum clearance of 8 inches and a maximum of 12 inches on each side of the pipe and to the top of the pipe with a minimum overdepth of 4 inches. If cinders are encountered at bottom of trench, increase overdepth to 10 inches.
 - 2. Sides shall be vertical unless otherwise required by governing safety regulations.
 - 3. Provide manholes and similar structures with a minimum of 2-inch and a maximum of 24-inch clearance on each side.
- H. Backfill
 - 1. Use only backfill material free of organic matter, cinders, frozen earth, clay, and rocks exceeding 6 inches in any dimension.

2. Provide bed of firmly compacted sand, gravel, or crushed stone of proper grade to form a uniform support. Hollow out for bells. Backfill excessive overdepth with firmly compacted sand or gravel.
3. Provide a structurally suitable reinforced concrete beam supported by the structure and undisturbed earth to support piping where a properly compacted bed is difficult to obtain, because of fill conditions, such as may occur adjacent to building walls.
4. As items to be buried are laid, backfill with layer of sand, crushed stone, or gravel bedding material to centerline of pipe or 6 inches deep, whichever is less, and tamp.
5. After tests and inspections are complete, backfill with fine earth or sand in 6-inch layers until buried item has 1-foot of cover. Carefully tamp each layer. Compact to at least 95 percent of the maximum dry density as determined by ASTM D 1557.
6. Deposit remainder of backfill material in 8-inch layers and tamp each layer. Compact to at least 95 percent of the maximum dry density as determined by ASTM D 1557.
7. Backfill with sand, graded crushed stone, or washed gravel, inside building under or within 3 feet of equipment and under roadways. Compact to at least 95 percent of the maximum dry density as determined by ASTM D 1557.

I. Restoring

1. Restore existing pavement, curbs, sidewalks, fences, sod, shrubs, and other appurtenances removed or damaged in connection with work to original condition.
2. Replace sod with sod and replace trees, which are damaged, with trees of similar type and size.

- J. Warning Tape: Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

END OF SECTION 23 05 00

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SECTION 23 05 29 - 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. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Equipment stands.
7. Equipment supports.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 230548 "Vibration Controls for HVAC" for vibration isolation devices.
3. Section 233113 "Metal Ducts" for duct hangers and supports.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. 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. Detail fabrication and assembly of trapeze hangers.
2. Include design calculations for designing trapeze hangers.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.
- 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, including pipe stands, 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.

2.2 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, hot-dip galvanized, or electro-galvanized.
3. Nonmetallic Coatings: Plastic coated, or epoxy powder-coated.
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 or stainless 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 and Tube Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-plated steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-plated steel or stainless steel.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-58, 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.

2.4 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business.
 - b. Cooper B-line; brand of Eaton, Electrical Sector.

- c. Flex-Strut Inc.
 - d. G-Strut.
 - e. Gripple Inc.
 - f. Unistrut; Atkore International.
- 2. Description: Shop- or field-fabricated, pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
 - 3. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 - 4. Channels: Continuous slotted carbon-steel channel with inturned lips.
 - 5. Channel Width: Selected for applicable load criteria.
 - 6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 - 7. Hanger Rods: Continuous-thread rod, nuts, and washer made of galvanized steel or stainless steel.
 - 8. Paint Coating: Green epoxy, acrylic, or urethane.

2.5 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Buckaroos, Inc.
 - 2. CADDY; brand of nVent Electrical plc.
 - 3. Carpenter & Paterson, Inc.
 - 4. KB Enterprise.
 - 5. National Pipe Hanger Corporation.
 - 6. Pipe Shields Inc.
 - 7. Piping Technology & Products, Inc.

- 8. Rilco Manufacturing Co., Inc.
- 9. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C552, Type II cellular glass with 100-psi or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psi minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with 100-psi. ASTM C552, Type II cellular glass with 100-psi or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psi minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 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.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - c. MKT Fastening, LLC.
- B. Mechanical-Expansion Anchors: Insert-wedge-type anchors for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper B-line; brand of Eaton, Electrical Sector.

- b. Hilti, Inc.
 - c. ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - d. MKT Fastening, LLC.
- 2. Indoor Applications: Zinc-coated or stainless steel.
 - 3. Outdoor Applications: Stainless steel.

2.7 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.8 OUTDOOR EQUIPMENT STANDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. MIRO Industries Inc.
 - 2. RectorSeal HVAC; a CSW Industrials Company.

2.9 MATERIALS

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011.
- C. Structural Steel: ASTM A36, carbon-steel plates, shapes, and bars; galvanized.
- D. Stainless Steel: ASTM A240.
- E. Threaded Rods: Continuously threaded. Zinc-plated or galvanized steel for indoor applications and stainless steel for outdoor applications. Mating nuts and washers of similar materials as rods.
- F. Grout: ASTM C1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 EXECUTION

3.1 APPLICATION

- A. 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.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Do not support pipes or equipment from ducts, pipes, etc.
- B. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- C. Metal Trapeze Pipe-Hanger Installation: This is a delegated design to be completed by the contractor. Comply with MSS SP-58. 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 A36/A36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- D. Metal Framing System Installation: This is a delegated design to be completed by the contractor. Arrange for grouping of parallel runs of piping, and support together on field-assembled strut systems.
- E. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- F. 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.

- G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- H. Equipment Support Installation: Fabricate from welded-structural-steel shapes. This is a delegated design to be completed by the contractor.
- I. Install hangers and supports to allow controlled thermal 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.
- J. Install lateral bracing with pipe hangers and supports to prevent swaying.
- K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, 2-1/2 inch 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.
- L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- M. 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.
- N. 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 4 inch 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 4 inch and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
 - a. 1/4 to 3-1/2 inches: 12 inches long and 0.048 inch thick.
 - b. 4 inches: 12 inches long and 0.06 inch thick.
5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. This is a delegated design to be completed by the contractor.
- C. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- D. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 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 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.

3.5 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.

3.6 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 A780.

3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 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, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper or stainless steel attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal-hanger shield inserts for insulated piping and tubing.

- I. 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 noninsulated or insulated, stationary pipes 1/2 to 30 inches.
 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes 4 to 24 inches, requiring up to 4 inches of insulation.
 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes 3/4 to 36 inches, requiring clamp flexibility and up to 4 inches of insulation.
 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes 1/2 to 24 inches if little or no insulation is required.
 5. Pipe Hangers (MSS Type 5): For suspension of pipes 1/2 to 4 inches, to allow off-center closure for hanger installation before pipe erection.
 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes 3/4 to 8 inches.
 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes 1/2 to 8 inches.
 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes 1/2 to 8 inches.
 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes 1/2 to 8 inches.
 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes 3/8 to 8 inches.
 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes 3/8 to 3 inches.
 12. U-Bolts (MSS Type 24): For support of heavy pipes 1/2 to 30 inches.
 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. Pipe Saddle Supports (MSS Type 36): For support of pipes 4 to 36 inches, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.

15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes 4 to 36 inches, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes 2-1/2 to 36 inches if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes 1 to 30 inches, from two rods if longitudinal movement caused by expansion and contraction might occur.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes 2-1/2 to 24 inches, from single rod if horizontal movement caused by expansion and contraction might occur.
 19. Complete Pipe Rolls (MSS Type 44): For support of pipes 2 to 42 inches if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is unnecessary.
 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes 2 to 24 inches if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is unnecessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes 2 to 30 inches if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- J. 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 3/4 to 24 inches.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers 3/4 to 24 inches if longer ends are required for riser clamps.
- K. 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.

3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- L. 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. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. 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.
- 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 - 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 - 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- M. 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.
- N. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 23 05 29

SECTION 23 05 48 - VIBRATION CONTROLS FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Spring hangers.
3. Snubbers.
4. Restraints - rigid type.
5. Restraints - cable type.
6. Restraint accessories.
7. Post-installed concrete anchors.
8. Concrete inserts.

1.2 DEFINITIONS

- A. IBC:** International Building Code.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Include load rating for each wind-force-restraint fitting and assembly.
3. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and wind-force-restraint component.
4. Annotate to indicate application of each product submitted and compliance with requirements.

5. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal:

1. For each wind-load protection device that is required by this Section or is indicated on Drawings, submit the following:
 - a. Vibration Isolator and Wind-Load-Restraint Selection: Select vibration isolators, wind-load restraints, and vibration isolation bases complying with performance requirements, design criteria, and analysis data.
 - b. Concrete Anchors and Inserts: Include calculations showing anticipated wind loads.
 - c. Wind-Load Design Calculations: Submit all static and dynamic loading calculations prepared under "Wind-Load Design Calculations" Paragraph in "Performance Requirements" Article.
 - d. Qualified Professional Engineer: All designated-design submittals for wind-restraint calculations are to be signed and sealed by qualified professional engineer responsible for their preparation.
2. Wind-Restraint Detail Drawing:
 - a. Design Analysis: To support selection and arrangement of wind restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to 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 wind events. Indicate association with vibration isolation devices.
 - c. Coordinate vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply also with requirements in other Sections for equipment mounted outdoors.
3. All delegated-design submittals for wind-restraint detail Drawings are to be signed and sealed by qualified professional engineer responsible for their preparation.

4. Product Listing, Preapproval, and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and basis for approval (tests or calculations).
5. Design Calculations for Vibration Isolation Devices: Calculate static and dynamic loading due to equipment weight and operating forces required to select proper vibration isolators, and to design vibration isolation bases.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints.
- B. Qualification Data: For testing agency.
- C. Welding certificates.
- D. Field quality-control reports.
- E. Wind-Force Performance Certification: Provide special certification for HVAC components subject to high wind exposure and impact damage and designated on Drawings or in the Specifications to require wind-force performance certification.
 1. Provide equipment manufacturer's written certification for each designated HVAC device, stating that it will remain in place and operable following the design wind event and comply with all requirements of authorities having jurisdiction.
 2. Provide manufacturer's written certification for each designated louver, damper, or similar device, stating that it will remain in place and protect opening from penetration of windborne debris and comply with all requirements of authorities having jurisdiction.
 3. Certification must be based on ICC-ES or similar nationally recognized testing standard procedures acceptable to authorities having jurisdiction.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct testing indicated, be an NRTL as defined by OSHA in 29 CFR 1910.7 and be acceptable to authorities having jurisdiction.

- B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Wind-Load-Restraint Device Load Ratings: Devices to be tested and rated in accordance with applicable code requirements and authorities having jurisdiction. Devices to be listed by a nationally recognized third party that requires periodic follow-up inspections and has a listing directory available to the public. Provide third-party listing by one or more of the following: an agency acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Schedule of Isolation is included in this specification section.
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design system.
 - 1. Wind-Load Performance: Equipment shall withstand the effects of high wind events as indicated on the structural drawings.
- C. Wind-Load Design Calculations:
 - 1. Perform calculations to obtain force information necessary to properly select wind-load-restraint devices, fasteners, and anchorage. Perform calculations using factors indicated on structural drawings.
- D. Consequential Damage: Provide additional restraints for suspended HVAC components or anchorage of floor-, roof-, or wall-mounted HVAC components as indicated in ASCE/SEI 7-16 so that failure of a non-essential or essential HVAC component will not cause the failure of any other essential architectural, mechanical, or electrical building component.
- E. Fire/Smoke Resistance: All components that are not constructed of ferrous metals must have a maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested by an NRTL in accordance with ASTM E84 or UL 723, and be so labeled.
- F. Component Supports:
 - 1. Load ratings, features, and applications of all reinforcement components must be based on testing standards of a nationally recognized testing agency.

- G. Select isolators for uniform static deflections according to distribution of weight and to meet requirements shown elsewhere in the Contract Documents.
- H. Select isolators for not less than the deflections indicated on the Schedule.
- I. Select vibration isolation for stable operation during starting and stopping of equipment without excessive movement of equipment.
- J. Corrosion Resistance: All springs and associated metal hardware shall be designed or treated for resistance to corrosion. Steel components shall be PVC coated, or phosphated and painted with industrial grade enamel. All nuts, bolts and washers shall be zinc electroplated. Structural steel bases and exposed steel components of concrete inertia bases shall be cleaned of welding slag and primed with zinc-chromate or metal etching primer. A finish coat of industrial grade enamel shall be applied over the primer.
- K. Outdoor Locations: Steel parts PVC coated, hot-dip galvanized, zinc-electroplated plus coating of neoprene, bitumastic paint, or powdered coating. Aluminum components for outdoor installation shall be etched and painted with industrial grade enamel. Nuts, bolts, and washers may be zinc-electroplated.
- L. Springs: all springs shall be fully color-coded to indicate capacity, color striping is not considered adequate.

2.2 ELASTOMERIC ISOLATION PADS

A. TYPE D1

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. Korfund.
 - c. Mason Industries, Inc.
 - d. VMC GROUP.
 - e. Vibration Eliminator Co., Inc.
- 2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
- 3. Size: Factory or field cut to match requirements of supported equipment.

4. Minimum deflection as scheduled.
5. Pad Material: Oil- and water-resistant rubber.
6. Infused nonwoven cotton or synthetic fibers.
7. Load-bearing metal plates adhered to pads where necessary to spread loads.
8. Sandwich-Core Material: Resilient and elastomeric.
 - a. Infused nonwoven cotton or synthetic fibers.

B. TYPE D2

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. Korfund.
 - c. Mason Industries, Inc.
 - d. VMC GROUP.
 - e. Vibration Eliminator Co., Inc.
2. Same as Type D1, except as follows:
 - a. Cemented steel plate on top with a 3/4-inch diameter center hole for bolting through.
 - b. Include a 3/4-inch neoprene isolation washer cemented to a steel washer.

C. TYPE E

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. Korfund.
 - c. Mason Industries, Inc.

- d. VMC GROUP.
 - e. Vibration Eliminator Co., Inc.
2. Closed cell neoprene strip, 4-inches wide, $\frac{3}{4}$ inch thick.

2.3 SPRING HANGERS

A. TYPE G

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. VMC GROUP.
 - d. Vibration Eliminator Co., Inc.
2. 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.
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. Minimum deflection as scheduled.
7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
8. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
9. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.4 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. VMC GROUP.
- B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
1. Post-Installed Concrete Anchor Bolts: Secure to concrete surface with post-installed concrete anchors. Anchors to be prequalified in accordance with ACI 355.2 testing and designated in accordance with ACI 318-14 Ch. 17 for 2015 or 2018 IBC.
 2. Preset Concrete Inserts: Prequalified in accordance with ICC-ES AC446 testing.
 3. Anchors in Masonry: Design in accordance with TMS 402.
 4. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 5. Resilient Cushion: Maximum 1/4-inch air gap, and minimum 1/4 inch thick.

2.5 RESTRAINTS - RIGID TYPE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper B-line; brand of Eaton, Electrical Sector.
 2. Hilti, Inc.
 3. Unistrut; Atkore International.
 4. VMC GROUP.
- B. Description: Shop- or field-fabricated bracing assembly made of AISI S110-07-S1 slotted steel channels, ANSI/ASTM A53 steel pipe as per NFPA 13, or other rigid steel brace member. Includes 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.

2.6 RESTRAINTS - CABLE TYPE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CADDY; brand of nVent Electrical plc.
 - 2. Cooper B-line; brand of Eaton, Electrical Sector.
 - 3. Gripple Inc.
 - 4. Loos & Co. Inc.
 - 5. VMC GROUP.
- B. Restraint Cables: ASTM A1023 galvanized or ASTM A603 galvanized-steel. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with fittings attached by means of poured socket, swaged socket, or mechanical (Flemish eye) loop.
- C. Restraint cable assembly and cable fittings must comply with ASCE/SEI 19-10. All cable fittings and complete cable assembly must maintain the minimum cable breaking force. U-shaped cable clips and wedge-type end fittings do not comply and are unacceptable.

2.7 RESTRAINT ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-line; brand of Eaton, Electrical Sector.
 - 2. Hilti, Inc.
 - 3. Mason Industries, Inc.
 - 4. Unistrut; Atkore International.
- B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

- D. 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.
- E. 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.
- F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.8 POST-INSTALLED CONCRETE ANCHORS

A. Mechanical Anchor Bolts:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper B-line; brand of Eaton, Electrical Sector.
 - b. Hilti, Inc.
 - c. Mason Industries, Inc.
 - d. Unistrut; Atkore International.
- 2. 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 for anchor and as tested according to ASTM E488.

B. Adhesive Anchor Bolts:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper B-line; brand of Eaton, Electrical Sector.
 - b. Hilti, Inc.
 - c. Mason Industries, Inc.
 - d. Unistrut; Atkore International.
- 2. Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications

and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

- C. Provide post-installed concrete anchors that have been prequalified for use in wind-load applications. Post-installed concrete anchors must comply with all requirements of ASCE/SEI 7-05, Ch. 13, ASCE/SEI 7-10, Ch. 13, ASCE/SEI 7-16, Ch. 13.
 - 1. Prequalify post-installed anchors in concrete in accordance with ACI 355.2 or other approved qualification testing procedures.
 - 2. Prequalify post-installed anchors in masonry in accordance with approved qualification procedures.

2.9 CONCRETE INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-line; brand of Eaton, Electrical Sector.
 - 2. Hilti, Inc.
 - 3. Mason Industries, Inc.
 - 4. Unistrut; Atkore International.
- B. Provide preset concrete inserts that are prequalified in accordance with ICC-ES AC466 testing.
- C. Comply with ANSI/MSS SP-58.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and wind-load control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Strength of Support Assemblies: The minimum static deflection of the first three hangers shall equal that of the isolators supporting the equipment. Thereafter, provide isolators with 1/2 the static deflection capabilities of the isolation system of the equipment to which it is connected.

3.3 INSTALLATION OF VIBRATION AND WIND-LOAD CONTROL DEVICES

- A. Provide vibration and wind-load control devices for systems and equipment as scheduled in this section, where Specifications indicate they are to be installed on specific equipment and systems, and where required by applicable codes.
- B. Coordinate 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."
- C. Installation of vibration isolators and wind-load restraints must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- D. Install isolators in locations to permit inspection and adjustment, and to provide proper operation. Install isolators as high as possible in hanger rod assembly, but clear of structure. Maintain 2-inch clearance between isolated equipment and walls, ceilings and other equipment. Maintain side clearance for hanger housings to allow a full 360-degree hanger rotation about the rod axis without contacting any object. Isolated systems shall be independently supported.
- E. Equipment Restraints:
 - 1. Install snubbers or thrust restraint isolation on HVAC equipment mounted on vibration isolators to prevent movement in excess of 1/4-inch due to dynamic forces. Locate snubbers or thrust restraint as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 - 2. Mount equipment on steel base of adequate structural rigidity when equipment or frame is not structurally suitable for the type of isolation specified. Spring and rail and spring supports are specified on the basis that the equipment is structurally built or supported on a rigid frame. Isolators for equipment with bases shall be located on sides of the base, which are parallel to the equipment shaft.

3. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 4. Install wind-load-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- F. Install wind-load-restraint cables so they do not bend across edges of adjacent equipment or building structure.
- G. Install wind-load-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction 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. Provide structural base plate under isolator where isolator is wider than supporting structural member. Tack weld plate to structural member.
- K. Post-Installed Concrete 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 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-Type Anchor Bolts: 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-Type Anchor Bolts: 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 EQUIPMENT ISOLATION SCHEDULE

A. If the mount baseplate is bolted to structure or framework rigidly connected to the structure, elastomeric grommets shall be used between each bolt and the baseplate to prevent rigid connection. These additional neoprene washers and bushings may be omitted if the baseplate and friction pad incorporate neoprene elements that eliminate rigid contact between bolts and the baseplate. Bolt holes shall be properly sized to allow for bushing sleeve. The anchor bolt shall incorporate steel washers to distribute load evenly over neoprene washers.

B. Equipment Isolation Schedule

TYPE OF EQUIPMENT	SUPPORTING STRUCTURE			
	FLOOR SLAB ON EARTH		OTHER FLOOR AND ROOF	
	ISOLATION BASE TYPE	MIN. STATIC DEFLECTION IN INCHES	ISOLATION BASE TYPE	MIN. STATIC DEFLECTION IN INCHES
Energy Recovery Ventilators and Multi-positional Fan Coil Units				
Suspended				
thru 5 HP	-	-	G	1.0 Note 1
7-1/2 HP and Over				
275-400 rpms	-	-	G	1.75 Note 1
401 rpm and Over	-	-	G	1.0
Floor Mounted with Inter- nally Mounted Motor and Drive	D1+E	0.10	D1+E	0.10
Heat Pump Units	D2	0.1	D2	0.1
Unit Heaters – Suspended	-	-	G	1.0 Note 1

NOTES:

- 1) Spring Deflection

3.5 ADJUSTING

A. Adjust isolators after 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.
- C. Adjust leveling bolts and hanger rod bolts so that isolated equipment is level and in proper alignment with connecting ducts and pipes. All vibration isolators shall be aligned squarely above or below mounting points of supported equipment.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections with the assistance of a factory-authorized service representative.
- 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.

END OF SECTION 23 05 48

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SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Warning tape.
4. Pipe labels.
5. Duct labels.
6. Warning tags.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

PART 2 PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Craftmark Pipe Markers.
 - c. Seton Identification Products; a Brady Corporation company.
2. Material and Thickness: Brass, 0.032-inch minimum thickness, with predrilled or stamped holes for attachment hardware.

3. Letter and Background Color: As indicated for specific application under Part 3.
 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 of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths 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. 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.

2.2 WARNING SIGNS AND LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Brady Corporation.
 2. Craftmark Pipe Markers.
 3. Seton Identification Products; a Brady Corporation company.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, with predrilled holes for attachment hardware.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Maximum Temperature: Able to withstand temperatures of 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 of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

- G. Fasteners: Stainless steel rivets or self-taping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Arc-Flash Warning Signs: Provide arc-flash warning signs in locations and with content in accordance with requirements of OSHA and NFPA70E and other applicable codes and standards.
- J. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 WARNING TAPE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Brady Corporation.
 - 2. Craftmark Pipe Markers.
 - 3. Seton Identification Products; a Brady Corporation company.
- B. Material: Vinyl.
- C. Minimum Thickness: 0.005 inch.
- D. Letter, Pattern, and Background Color: As indicated for specific application under Part 3.
- E. Waterproof Adhesive Backing: Suitable for indoor or outdoor use.
- F. Maximum Temperature: 160 deg F.
- G. Minimum Width: 2 inches.

2.4 PIPE LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Brady Corporation.
 - 2. Craftmark Pipe Markers.
 - 3. Seton Identification Products; a Brady Corporation company.

- B. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- E. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- F. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:
 - 1. Pipe size.
 - 2. Flow-Direction Arrows: Include flow-direction arrows on distribution piping. Arrows may be either integral with label or applied separately.
 - 3. Lettering Size: At least 1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.

2.5 DUCT LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Brady Corporation.
 - 2. Craftmark Pipe Markers.
 - 3. Seton Identification Products; a Brady Corporation company.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- 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 of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths 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 the following:
 - 1. Duct size.
 - 2. Flow-Direction Arrows: Include flow-direction arrows on distribution ducts. Arrows may be either integral with label or may be applied separately.
 - 3. Lettering Size: At least 1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.

2.6 WARNING TAGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Brady Corporation.
 - 2. Craftmark Pipe Markers.
 - 3. Seton Identification Products; a Brady Corporation company.
- B. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches minimum.
 - 2. Fasteners: Reinforced grommet and wire or string.
 - 3. Nomenclature: Large-size primary caption, such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Letter and Background Color: As indicated for specific application under Part 3.

PART 3 EXECUTION

3.1 PREPARATION

- A. Clean piping, ductwork and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION, GENERAL REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

- A. Permanently fasten labels on each item of mechanical equipment.
- B. Sign and Label Colors:
 - 1. White letters on an ANSI Z535.1 safety-blue background.
- C. Locate equipment labels where accessible and visible.
- D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where arc-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.
- E. Equipment requiring identification is all equipment specified in Division 23.

3.4 INSTALLATION OF WARNING TAPE

- A. Warning Tape Color and Pattern: Yellow background with black diagonal stripes.
- B. Install warning tape on pipes and ducts, with cross-designated walkways providing less than 6 ft. of clearance.
- C. Locate tape so as to be readily visible from the point of normal approach.

3.5 INSTALLATION OF PIPE LABELS

- A. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
- 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 and plenums; and exterior exposed locations as follows:
 - 1. Within 3 ft. of each valve and control device.
 - 2. At access doors and similar access points that permit view of concealed piping.
 - 3. Within 3 ft. of equipment items and other points of origination and termination.
 - 4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping, ductwork, and equipment.
- C. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.
- D. Flow-Direction Arrows: Use arrows to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- E. Pipe-Label Color Schedule:
 - 1. Refrigerant Piping: White letters on an ANSI Z535.1 safety-blue background.

3.6 INSTALLATION OF DUCT LABELS

- A. Install self-adhesive duct labels showing service and flow direction with permanent adhesive on air ducts.
 - 1. Provide labels in the following color codes:
 - a. For air supply ducts: White letters on blue background.
 - b. For air return ducts: White letters on blue background.
 - c. For exhaust-, outside-, relief-, return-, and mixed-air ducts: White letters on blue background.

- B. Locate label near each point where ducts enter into and exit from concealed spaces and at maximum intervals of 20 ft. where exposed or are concealed by removable ceiling system.
- C. Stenciled Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:
 - 1. Black letters on White background.

3.7 INSTALLATION OF WARNING TAGS

- A. Warning Tag Color: Black letters on an ANSI Z535.1 safety-yellow background.
- B. Attach warning tags, with proper message, to equipment and other items where indicated on Drawings and scheduled.

END OF SECTION 23 05 53

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Testing, Adjusting, and Balancing of Air Systems:
 - a. Constant-volume air systems.
2. Testing, adjusting, and balancing of equipment.
3. Duct leakage tests verification.
4. Pipe leakage tests verification.

1.2 DEFINITIONS

- A. NEBB: National Environmental Balancing Bureau.
- B. TAB: Testing, adjusting, and balancing.
- C. TABB: Testing, Adjusting, and Balancing Bureau.
- D. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- E. TDH: Total dynamic head.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 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. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists, as specified in "Preparation" Article.

- E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.
- F. Certified TAB reports.
- G. Sample report forms.
- H. 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.

1.4 QUALITY ASSURANCE

- A. TAB Specialists Qualifications, Certified by NEBB:
 - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB.
 - 2. TAB Technician: Employee of the TAB specialist and certified by NEBB.
- B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."
- D. Code and AHJ Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

1.5 FIELD CONDITIONS

- A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 TAB SPECIALISTS

- A. Subject to compliance with requirements, engage one of the following:

[Certification Directory \(nebb.org\)](http://nebb.org)

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 installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and 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 ceiling plenums used for HVAC to verify that they are properly separated from adjacent areas and sealed.
- F. Examine equipment performance data, including fan curves.
1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as fan coil units, and verify that they are accessible and their controls are connected and functioning.
- K. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- L. Examine operating safety interlocks and controls on HVAC equipment.
- M. Examine control dampers for proper installation for their intended function of isolating, throttling, diverting, or mixing air flows.
- N. 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 the following:
 - 1. Equipment and systems to be tested.
 - 2. Strategies and step-by-step procedures for balancing the systems.
 - 3. Instrumentation to be used.
 - 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
 - 1. Airside:
 - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
 - b. Duct systems are complete with terminals installed.

- c. Volume dampers are open and functional.
- d. Clean filters are installed.
- e. Fans are operating, free of vibration, and rotating in correct direction.
- f. Variable-frequency controllers' startup is complete and safeties are verified.
- g. Ceilings are installed.
- h. Windows and doors are installed.
- i. Suitable access to balancing devices and equipment is provided.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system in accordance with the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
- B. Cut insulation, ducts, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
 - 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 230713 "Duct Insulation" and Section 230719 "HVAC Piping Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.5 TESTING, ADJUSTING, AND BALANCING OF HVAC EQUIPMENT

- A. Test, adjust, and balance HVAC equipment indicated on Drawings, including, but not limited to, the following:
 - 1. Motors.
 - 2. Energy-recovery ventilators.

3. Variable-refrigerant-flow systems.

3.6 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' Record drawings duct layouts.
- C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- D. 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.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check dampers for proper position to achieve desired airflow path.
- H. Check for airflow blockages.
- I. Check condensate drains for proper connections and functioning.
- J. Check for proper sealing of air-handling-unit components.

3.7 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. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
 - b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
 - c. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

2. Measure fan static pressures as follows:
 - a. Measure static pressure directly at the fan outlet or through the flexible connection.
 - b. Measure static pressure directly at the fan inlet or through the flexible connection.
 - c. Measure static pressure across each component that makes up the air-handling system.
 - d. Report artificial loading of filters at the time static pressures are measured.
 3. Review Contractor-prepared shop drawings and Record drawings to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 4. Obtain approval from Commissioning Authority 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.
 5. 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 occurs. 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.
1. Measure airflow of submain and branch ducts.
 2. Adjust submain and branch duct volume dampers for specified airflow.
 3. Re-measure each submain and branch duct after all have been adjusted.
- C. Adjust air inlets and outlets for each space to indicated airflows.
1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
 2. Measure inlets and outlets airflow.
 3. Adjust each inlet and outlet for specified airflow.

4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, speed, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

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. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.9 PROCEDURES FOR AIR-COOLED CONDENSING UNITS

- A. Verify proper rotation of fan(s).
- B. Measure and record entering- and leaving-air temperatures.
- C. Measure and record entering and leaving refrigerant pressures.
- D. Measure and record operating data of compressor(s), fan(s), and motors.

3.10 DUCT LEAKAGE TESTS

- A. Witness the duct leakage testing performed by Installer.
- B. Verify that proper test methods are used and that leakage rates are within specified limits.
- C. Report deficiencies observed.

3.11 PIPE LEAKAGE TESTS

- A. Witness the pipe pressure testing performed by Installer.
- B. Verify that proper test methods are used and that leakage rates are within specified limits.
- C. Report deficiencies observed.

3.12 TOLERANCES

- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
 - 2. Air Outlets and Inlets: Plus or minus 10 percent.
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.13 PROGRESS REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-balancing devices. Recommend changes and additions to system-balancing

devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance-measuring and -balancing devices.

- B. Status Reports: Prepare biweekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.14 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.
 3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Fan curves.
 2. Manufacturers' test data.
 3. Field test reports prepared by system and equipment installers.
 4. 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 specialist.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.

7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents, including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans 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. Heating coil, dry-bulb conditions.
 - e. Fan drive settings, including settings and percentage of maximum pitch diameter.
 - f. Variable-frequency controller settings for variable-air-volume systems.
 - g. Settings for pressure controller(s).
 - h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Duct, outlet, and inlet sizes.
3. Terminal units.
4. Balancing stations.
5. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units, include the following:

1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches, and bore.
 - i. Center-to-center dimensions of sheave and amount of adjustments in inches.
 - j. Number, make, and size of belts.
 - k. Number, type, and size of filters.
2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and speed.

- c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave and amount of adjustments in inches.
- 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan speed.
 - d. Inlet and discharge static pressure in inches wg.
 - e. For each filter bank, filter static-pressure differential in inches wg.
 - f. Cooling-coil static-pressure differential in inches wg.
 - g. Heating-coil static-pressure differential in inches wg.
 - h. List for each internal component with pressure-drop, static-pressure differential in inches wg.
 - i. Outdoor airflow in cfm.
 - j. Return airflow in cfm.
 - k. Outdoor-air damper position.
 - l. Return-air damper position.

F. Apparatus-Coil Test Reports:

- 1. Coil Data:
 - a. System identification.
 - b. Location.
 - c. Coil type.

- d. Number of rows.
 - e. Fin spacing in fins per inch o.c.
 - f. Make and model number.
 - g. Face area in sq. ft.
 - h. Tube size in NPS.
 - i. Tube and fin materials.
 - j. Circuiting arrangement.
2. Test Data (Indicated and Actual Values):
- a. Airflow rate in cfm.
 - b. Average face velocity in fpm.
 - c. Air pressure drop in inches wg.
 - d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
 - e. Return-air, wet- and dry-bulb temperatures in deg F.
 - f. Entering-air, wet- and dry-bulb temperatures in deg F.
 - g. Leaving-air, wet- and dry-bulb temperatures in deg F.
 - h. Refrigerant expansion valve and refrigerant types.
 - i. Refrigerant suction pressure in psig.
 - j. Refrigerant suction temperature in deg F.

G. Fan Test Reports: For supply, return, and exhaust fans, include the following:

- 1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.

- d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches, and bore.
 - h. Center-to-center dimensions of sheave and amount of adjustments in inches.
2. Motor Data:
- a. Motor make, and frame type and size.
 - b. Horsepower and speed.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave and amount of adjustments in inches.
 - g. Number, make, and size of belts.
3. Test Data (Indicated and Actual Values):
- a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan speed.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.

H. Round and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:
- a. System fan and air-handling-unit number.

- b. Location and zone.
- c. Traverse air temperature in deg F.
- d. Duct static pressure in inches wg.
- e. Duct size in inches.
- f. Duct area in sq. ft.
- g. Indicated airflow rate in cfm.
- h. Indicated velocity in fpm.
- i. Actual airflow rate in cfm.
- j. Actual average velocity in fpm.
- k. Barometric pressure in psig.

I. 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. Airflow rate in cfm.

- b. Air velocity in fpm.
- c. Preliminary airflow rate as needed in cfm.
- d. Preliminary velocity as needed in fpm.
- e. Final airflow rate in cfm.
- f. Final velocity in fpm.
- g. Space temperature in deg F.

J. Instrument Calibration Reports:

- 1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.15 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Commissioning Authority.
- B. Commissioning Authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to the lesser of either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- C. 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."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the TAB shall be considered incomplete and shall be rejected.

- E. If recheck measurements find the number of failed measurements noncompliant with requirements indicated, proceed as follows:
 - 1. TAB specialists shall 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. All changes shall be tracked to show changes made to previous report.
 - 2. If the second final inspection also fails, Owner may pursue others Contract options to complete TAB work.
- F. Prepare test and inspection reports.

3.16 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- 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 23 07 13 - DUCT INSULATION

PART 1 GENERAL

1.1 SUMMARY

A. Section includes insulating the following duct services:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
4. Indoor, exposed exhaust between isolation damper and penetration of building exterior.

B. Related Requirements:

1. Section 230719 "HVAC Piping Insulation."

1.2 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).

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or craft training program.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers are to be marked with the manufacturer's name, appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 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.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and. Insulation application may begin on segments that have satisfactory test results.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84 or UL723, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.

- 1. All Insulation Installed Indoors; Outdoors-Installed Insulation in Contact with Airstream: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General" and "Indoor Duct and Plenum Insulation Schedule" articles for where insulating materials are to be applied.
- B. Products do not contain asbestos, lead, mercury, or mercury compounds.

- C. Products that come in contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.
- F. Glass-Fiber Blanket: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 450 deg F in accordance with ASTM C411. Comply with ASTM C553, Type II, and ASTM C1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed; SAINT-GOBAIN.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Manson Insulation Inc.
 - e. Owens Corning.
- G. Glass-Fiber Board Insulation: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F and 250 deg F for jacketed and between 35 deg F and 450 deg F for unfaced in accordance with ASTM C411. Comply with ASTM C612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed; SAINT-GOBAIN.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Manson Insulation Inc.

- e. Owens Corning.
- H. Glass-Fiber, Pipe and Tank: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F and 850 deg F, in accordance with ASTM C411. Comply with ASTM C1393.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed; SAINT-GOBAIN.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Manson Insulation Inc.
 - e. Owens Corning.
 - 2. Semirigid board material with factory-applied FSK jacket.
 - 3. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.3 ADHESIVES

- A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Glass-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller.
 - d. Mon-Eco Industries, Inc.
- C. FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller.
 - d. Mon-Eco Industries, Inc.

2.4 MASTICS AND COATINGS

- A. Materials are compatible with insulation materials, jackets, and substrates.
- B. Vapor-Retarder Mastic, Water Based, Interior Use: Suitable for indoor use on below ambient services.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller.
 - c. Knauf Insulation.
 - d. Vimasco Corporation.
 2. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Comply with MIL-PRF-19565C, Type II, for permeance requirements.
 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.

- b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller.
 - d. Knauf Insulation.
 - e. Mon-Eco Industries, Inc.
 - f. Vimasco Corporation.
- 2. Water-Vapor Permeance: ASTM E96, greater than 1.0 perm at manufacturer's recommended dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Color: White.

2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and are compatible with insulation materials, jackets, and substrates.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller.
 - c. Vimasco Corporation.
 - 2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
 - 3. Service Temperature Range: 0 to plus 180 deg F.
 - 4. Color: White.

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. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

2.7 FIELD-APPLIED JACKETS

- A. Field-applied jackets comply with ASTM C921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Mesh: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. in. for covering ducts.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller.
- B. Woven Polyester Mesh: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for ducts.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller.
 - c. Vimasco Corporation.

2.9 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Cloth: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Alpha Associates, Inc.

2.10 TAPES

- A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Industrial Adhesives and Tapes Division.
 - b. Avery Dennison Corporation, Specialty Tapes Division.
 - c. Ideal Tape Co., Inc., an American Biltrite Company.
 - d. Knauf Insulation.
2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Industrial Adhesives and Tapes Division.
 - b. Avery Dennison Corporation, Specialty Tapes Division.
 - c. Ideal Tape Co., Inc., an American Biltrite Company.
 - d. Knauf Insulation.
 - e. Sekisui Voltek, LLC.
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.

2.11 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. RPR Products, Inc.
2. Stainless Steel: ASTM A240, Type 316; 0.015 inch thick, 1/2 inch wide with wing seal.
3. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing 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. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) AGM Industries, Inc.
 - 2) CL WARD & Family Inc.
 - 3) Gemco.
 - 4) Midwest Fasteners, Inc.
 - 5) Nelson Stud Welding.

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 Products.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. RPR Products, Inc.

2.12 CORNER ANGLES

- A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum in accordance with ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.
- B. Stainless Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel in accordance with ASTM A240, 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. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, jackets, and thicknesses required for each item of duct 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, compress, or otherwise damage insulation or jacket.
- 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. Keep insulation materials dry during application and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Vapor barrier installation: 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.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
 - 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. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
 - a. 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.
- L. Cut insulation in a manner to avoid compressing insulation.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. 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.
- O. 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.
- P. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- Q. 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.

3.4 INSTALLATION OF GLASS-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

B. Comply with manufacturer's written installation instructions.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 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 and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches 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 overcompress 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, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch 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 60 deg F at 18-foot intervals. Vapor stops 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.
5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches 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- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- C. 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 50 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 and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches 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 overcompress 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, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch 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 60 deg F at 18-foot intervals. Vapor stops 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.
- 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 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- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.5 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 overlap at seams and joints.
 - 2. Embed glass cloth between two 0.062-inch- 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 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.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection is 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.

3.7 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
4. Indoor, exposed exhaust between isolation damper and penetration of building exterior.

B. Plenums and Ducts Requiring Vapor Barrier:

1. Indoor, concealed supply and outdoor air.

2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
4. Indoor, exposed exhaust between isolation damper and penetration of building exterior.

C. 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. Factory-insulated plenums and casings.
4. Flexible connectors.
5. Vibration-control devices.
6. Factory-insulated access panels and doors.

3.8 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, round, supply-air duct insulation is the following:

1. Glass-Fiber Blanket: 2-3/16 inches thick and 0.75 lb/cu. ft. nominal density.

B. Concealed, round, outdoor-air duct insulation is the following:

1. Glass-Fiber Blanket: 3 inches thick and 0.75 lb/cu. ft. nominal density.

C. Concealed, rectangular, supply-air duct insulation is the following:

1. Glass-Fiber Blanket: 2-3/16 inches thick and 0.75 lb/cu. ft. nominal density.

D. Concealed, rectangular, outdoor-air duct insulation is the following:

1. Glass-Fiber Blanket: 3 inches thick and 0.75 lb/cu. ft. nominal density.

E. Concealed, rectangular, exhaust-air duct insulation between isolation damper and penetration of building exterior is the following:

1. Glass-Fiber Blanket: 3 inches thick and 0.75 lb/cu. ft. nominal density.

- F. Concealed, supply-air plenum insulation is the following:
 - 1. Glass-Fiber Blanket: 2-3/16 inches thick and 0.75 lb/cu. ft. nominal density.
- G. Concealed, outdoor-air plenum insulation is the following:
 - 1. Glass-Fiber Blanket: 3 inches thick and 0.75 lb/cu. ft. nominal density.
- H. Concealed, exhaust-air plenum insulation is the following:
 - 1. Glass-Fiber Blanket: 3 inches thick and 0.75 lb/cu. ft. nominal density.
- I. Exposed, round, supply-air duct insulation is the following:
 - 1. Glass-Fiber Pipe and Tank: 2 inches thick.
- J. Exposed, round, outdoor-air duct insulation is the following:
 - 1. Glass-Fiber Pipe and Tank: 3 inches thick.
- K. Exposed, rectangular, supply-air duct insulation is the following:
 - 1. Glass-Fiber Board: 1-1/2 inches thick and 1.6 lb/cu. ft. nominal density.
- L. Exposed, rectangular, outdoor-air duct insulation is the following:
 - 1. Glass-Fiber Board: 2 inches thick and 1.6 lb/cu. ft. nominal density.
- M. Exposed, supply-air plenum insulation is the following:
 - 1. Glass-Fiber Board: 1-1/2 inches thick and 1.6 lb/cu. ft. nominal density.
- N. Exposed, outdoor-air plenum insulation is the following:
 - 1. Glass-Fiber Board: 2 inches thick and 1.6 lb/cu. ft. nominal density.
- O. Exposed, exhaust-air plenum insulation is the following:
 - 1. Glass-Fiber Board: 2 inches thick and 1.6 lb/cu. ft. nominal density.

3.9 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. Ducts and Plenums, Concealed:

1. FSK

D. Ducts and Plenums, Exposed in mechanical equipment rooms:

1. Field-Applied Fabric-Reinforcing Mesh
2. Field-Applied Cloths

END OF SECTION 23 07 13

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SECTION 23 07 19 - HVAC PIPING INSULATION

PART 1 GENERAL

1.1 SUMMARY

A. Section includes insulation for HVAC piping systems.

B. Related Requirements:

1. Section 230713 "Duct Insulation" for duct insulation.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied, if any).

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or craft training program, certified by the Department of Labor, Bureau of Apprenticeship and Training.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation system materials are to be delivered to the Project site in unopened containers. The packaging is to include name of manufacturer, fabricator, type, description, and size, as well as ASTM standard designation, and maximum use temperature.

1.6 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 piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84 or UL723 by a testing agency acceptable to authority having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
 - 1. All Insulation Installed Indoors and Outdoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," and "Outdoor, Aboveground Piping Insulation Schedule" articles for where insulating materials are applied.
- B. Products do not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell, or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F and 220 deg F. Comply with ASTM C534, Type I, for tubular materials, Type II for sheet materials.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA.
 - b. Armacell LLC.
 - c. K-Flex USA.
- G. Glass-Fiber, Preformed Pipe: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 850 deg F in accordance with ASTM C411. Comply with ASTM C547.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. Knauf Insulation.
 - c. Manson Insulation Inc.
 - d. Owens Corning.
 2. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ.
 3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
 4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- H. Glass-Fiber, Pipe and Tank: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F and 850 deg F, in accordance with ASTM C411. Comply with ASTM C1393.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed; SAINT-GOBAIN.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Manson Insulation Inc.

- e. Owens Corning.
- 2. Semirigid board material with factory-applied ASJ jacket.
- 3. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.3 INSULATING CEMENTS

A. Glass-Fiber Insulating Cement: Comply with ASTM C195.

- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ramco Insulation, Inc.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C196.

- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ramco Insulation, Inc.

C. Glass-Fiber Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.

- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ramco Insulation, Inc.

2.4 ADHESIVES

A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric Adhesive: Solvent-based adhesive.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA.
 - b. Armacell LLC.

- c. K-Flex USA.
 - 2. Flame-spread index is 25 or less and smoke-developed index is 50 or less as tested in accordance with ASTM E84.
 - 3. Wet Flash Point: Below 0 deg F.
 - 4. Service Temperature Range: 40 to 200 deg F.
 - 5. Color: Black.
- C. Glass-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller.
 - c. Mon-Eco Industries, Inc.
- D. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller.
 - c. Mon-Eco Industries, Inc.
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. P.I.C. Plastics, Inc.
 - c. Proto Corporation.

- d. Sekisui Voltek, LLC.
- e. Speedline Corporation.
- f. The Dow Chemical Company.

2.5 MASTICS AND COATINGS

- A. Materials are compatible with insulation materials, jackets, and substrates.
- B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller.
 - c. Knauf Insulation.
 - d. Mon-Eco Industries, Inc.
 - e. Vimasco Corporation.
 - 2. Water-Vapor Permeance: Comply with ASTM E96 or ASTM F1249.
 - 3. Service Temperature Range: 0 to plus 180 deg F.
 - 4. Comply with MIL-PRF-19565C, Type II, for permeance requirements, with supplier listing on DOD QPD - Qualified Products Database.
 - 5. Color: White.
- C. Vapor-Retarder Mastic, Solvent Based, Outdoor Use: Suitable for outdoor use on below-ambient services.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller.

2. Water-Vapor Permeance: Comply with ASTM E96 or ASTM F1249.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Color: White.

D. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller.
 - c. Knauf Insulation.
 - d. Mon-Eco Industries, Inc.
 - e. Vimasco Corporation.
2. Water-Vapor Permeance: ASTM E96, greater than 1.0 perm at manufacturer's recommended dry film thickness.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Color: White.

2.6 LAGGING ADHESIVES

A. Adhesives comply with MIL-A-3316C, Class I, Grade A, and are compatible with insulation materials, jackets, and substrates.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller.
 - c. Vimasco Corporation.
2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.

3. Service Temperature Range: 20 to plus 180 deg F.
4. Color: White.

2.7 SEALANTS

A. Materials are as recommended by the insulation manufacturer and are compatible with insulation materials, jackets, and substrates.

B. Joint Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller.
 - c. Mon-Eco Industries, Inc.
 - d. Owens Corning.
2. Permanently flexible, elastomeric sealant.
 - a. Service Temperature Range: Minus 150 to plus 250 deg F.
 - b. Color: White or gray.

C. Metal Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller.
 - c. Mon-Eco Industries, Inc.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.

D. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.8 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 C1136, Type I.

2.9 FIELD-APPLIED JACKETS

- A. Field-applied jackets comply with ASTM C1136, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Airex Manufacturing Inc.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. P.I.C. Plastics, Inc.
 - d. Proto Corporation.
 - e. Speedline Corporation.
 2. Adhesive: As recommended by jacket material manufacturer.

3. Color: White.
4. 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. Metal Jacket:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. RPR Products, Inc.
2. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing or factory cut and rolled to size.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 53-mil- thick, heat-bonded polyethylene and kraft paper.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.

- 6) Beveled collars.
- 7) Valve covers.
- 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.10 FIELD-APPLIED FABRIC REINFORCING MESH

A. Woven Glass-Fiber Mesh: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Childers Brand; H. B. Fuller Construction Products.

B. Woven Polyester Mesh: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller.
 - c. Vimasco Corporation.

2.11 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Cloth: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Alpha Associates, Inc.

2.12 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Industrial Adhesives and Tapes Division.
 - b. Avery Dennison Corporation, Specialty Tapes Division.
 - c. Ideal Tape Co., Inc., an American Biltrite Company.
 - d. Knauf Insulation.
 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. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Industrial Adhesives and Tapes Division.
 - b. Ideal Tape Co., Inc., an American Biltrite Company.
 2. Width: 2 inches.
 3. Thickness: 6 mils.
 4. Adhesion: 64 ounces force/inch in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch in width.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Industrial Adhesives and Tapes Division.
 - b. Avery Dennison Corporation, Specialty Tapes Division.
 - c. Ideal Tape Co., Inc., an American Biltrite Company.
 - d. Knauf Insulation.
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.

2.13 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. RPR Products, Inc.
2. Stainless Steel: ASTM A240, Type 316; 0.015 inch thick, 1/2 inch wide with wing seal.
3. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing 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.

A. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

B. 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 Products.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. RPR Products, Inc.

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. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.3 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 of 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, compress, or otherwise damage insulation or jacket.

- D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) 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 storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with the Contract Documents.
- 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 attached to structure with vapor-barrier mastic.
 - 3. Install insert materials and 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, but not to the extent of creating wrinkles or areas of compression in the insulation.

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.
4. For below-ambient services, apply vapor-barrier mastic over staples.
5. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
6. 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.

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 in similar fashion 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.

3.4 PENETRATIONS

A. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations 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 Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.

3.5 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 below.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using prefabricated fitting insulation or mitered or routed fittings made from same material and density as that of adjacent pipe insulation. Each piece is 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 prefabricated fitting insulation or sectional pipe insulation of same material and thickness as that 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 prefabricated fitting insulation or sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 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 prefabricated fitting insulation or sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 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, mechanical couplings, and unions using a section of oversized preformed pipe insulation to fit. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
 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 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, 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.
- 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. Installation conforms 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 that of adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 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.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Installation shall follow the manufacturer's installation instructions or ASTM C 1710.

B. 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.

C. Insulation Installation on Pipe Flanges:

1. Slit tubular sections and apply onto piping or tubing. Alternatively, slide un-slit sections over the open ends of piping or tubing.
2. 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. Insulation must be installed in compression to allow for expansion and contraction.
4. Insulation shall be pushed onto the pipe, never pulled. Stretching of insulation may result in open seams and joints.
5. For below-ambient systems, adhere the insulation to the pipe at least every 18 feet using manufacturer's adhesive. Completely terminate joints at critical points such as flanges, T-sections, elbows, supports, and similar fittings.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.

2. Install sections of pipe insulation and miter if required in accordance with manufacturer's written instructions.
3. 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.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. Install pipe insulation to outer diameter of pipe flange.
3. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
4. 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.
5. 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.

3.7 INSTALLATION OF GLASS-FIBER 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 jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with 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 prefabricated 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 glass-fiber or mineral-wool 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 prefabricated sections of same material as that of 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 prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated sections are not available, install fabricated 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 FIELD-APPLIED JACKETS

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 overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- 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 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.
- C. Where PVC jackets are indicated and for horizontal applications, 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.
- D. 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.

3.9 FINISHES

- A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- C. Do not field paint aluminum or stainless steel jackets.

3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
- B. Tests and Inspections: 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 is 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 if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.11 PIPING INSULATION SCHEDULE, GENERAL

- A. Insulation conductivity and thickness per pipe size comply with schedules in this Section or with requirements of authorities having jurisdiction, whichever is more stringent.
- B. 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.
- C. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Underground piping.
 - 2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.12 INDOOR PIPING INSULATION SCHEDULE

- A. Condensate and Equipment Drain Water below 60 Deg F:
 - 1. All Pipe Sizes: Insulation is one of the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- B. Refrigerant Suction and Hot-Gas Piping:
 - 1. All Pipe Sizes: Insulation is one of the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- C. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation is one of the following:

- a. Flexible Elastomeric: 2 inches thick.

D. Refrigerant Liquid Piping:

1. All Pipe Sizes: Insulation is one of the following:

- a. Flexible Elastomeric: 1 inch thick.
- b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

3.13 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation is one of the following:

- a. Flexible Elastomeric: 2 inches thick.
- b. Glass-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

B. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation is the following:

- a. Flexible Elastomeric: 2 inches thick.

C. Refrigerant Liquid Piping:

1. All Pipe Sizes: Insulation is one of the following:

- a. Flexible Elastomeric: 2 inches 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. ASJ

D. Piping, Exposed in mechanical equipment rooms:

1. Field-Applied Fabric-Reinforcing Mesh
2. Field-Applied Cloths

3.15 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. Piping, Concealed:

1. PVC: 30 mils thick.
2. Aluminum, Smooth: 0.024 inch thick.

D. Piping, Exposed:

1. Aluminum, Smooth with Z-Shaped Locking Seam: 0.024 inch thick.

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SECTION 23 23 00 - REFRIGERANT PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper tube and fittings.
2. Valves and specialties.
3. Refrigerants.

1.2 ACTION SUBMITTALS

A. Product Data Submittals: For each non packaged DX system.

1. Submit data for each type of refrigerant piping, fitting, valve, piping specialty, and refrigerant.

B. Delegated Design Submittals: For refrigerant piping size and 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.

C. 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.

1.3 INFORMATIONAL SUBMITTALS

A. Field Quality-Control Reports: For each field quality control test and inspection.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store piping with end caps in place to ensure that piping interior and exterior are clean when installed.
- B. Prepare valves and specialties for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads and other end connections.
- C. Use the following precautions during storage:
 - 1. Maintain valve and specialty end protection.
 - 2. Store valves and specialties indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," for refrigerant piping size and 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.
- B. For A2L refrigerants, comply with UL 484, UL/CSA 60335-2-40 or UL/CSA 60335-2-89.
- C. Comply with ASHRAE 15.
- D. Comply with ASME B31.5.

- E. Test Pressure for A2L Refrigerants R-32 and R-454B:
 - 1. Suction Tubing for Refrigeration and Air-Conditioning Applications Other than Heat Pumps: 300.
 - 2. Suction Tubing for Heat-Pump Applications: 535 psig.
 - 3. Hot-Gas and Tubing Lines: 535 psig.
- F. Test Pressure for Refrigerant R-410A:
 - 1. Suction Tubing for Refrigeration and Air-Conditioning Applications Other than Heat Pumps: 300 psig.
 - 2. Suction Tubing for Heat-Pump Applications: 535 psig.
 - 3. Hot-Gas and Tubing Lines: 535 psig.

2.2 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B280, Type ACR.
- B. Wrought-Copper Fittings, Solder Joint: ASME B16.22.
- C. Wrought-Copper Fittings, Brazed Joint: ASME B16.50.
- D. Wrought-Copper Unions: ASME B16.22.
- E. Solder Filler Metals: ASTM B32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- F. Brazing Filler Metals: AWS A5.8M/A5.8.
- G. 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 misalignment in minimum 7-inch- long assembly.
 - 4. Working Pressure Rating: Factory test at minimum 500 psig.
 - 5. Maximum Operating Temperature: 250 deg F.

2.3 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Danfoss, Inc.
 - b. Henry Technologies Inc.; The Henry Group.
 - c. Parker (Parker Hannifin).
2. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
3. Diaphragm: Phosphor bronze and stainless steel with stainless steel spring.
4. Operator: Rising stem and hand wheel.
5. Seat: Nylon.
6. End Connections: Socket, union, or flanged.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 240 deg F.

B. Packed-Angle Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Danfoss, Inc.
 - b. Henry Technologies Inc.; The Henry Group.
 - c. Parker (Parker Hannifin).
2. Body and Bonnet: Forged brass or cast bronze.
3. Packing: Molded stem, back seating, and replaceable under pressure.
4. Operator: Rising stem.

5. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
6. Seal Cap: Forged-brass or valox hex cap.
7. End Connections: Socket, union, threaded, or flanged.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 275 deg F.

C. Service Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Danfoss, Inc.
 - b. Emerson Climate Technologies; Emerson Electric Co.
 - c. Henry Technologies Inc.; The Henry Group.
 - d. JB Industries.
 - e. Parker (Parker Hannifin).
 - f. RectorSeal HVAC; a CSW Industrials Company.
 - g. Refrigeration Sales, Inc.
2. Body: Forged brass with brass cap, including key end to remove core.
3. Core: Removable ball-type check valve with stainless steel spring.
4. Seat: Polytetrafluoroethylene.
5. End Connections: Copper spring.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F.

D. Refrigerant Locking Caps:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. C & D Valve, LLC.
 - b. JB Industries.
 - c. RectorSeal HVAC; a CSW Industrials Company.
 - d. Refrigeration Sales, Inc.
2. Description: Locking-type, tamper-resistant, threaded caps to protect refrigerant-charging ports from unauthorized refrigerant access and leakage.
 3. Material: Brass, with protective shroud or sleeve.
 4. Refrigerant Identification: Color-coded, refrigerant specific based on AHRI Guideline N design.
 5. Special Tool: For installing and unlocking.

2.4 REFRIGERANTS

A. R-32, ASHRAE 34: Difluoromethane (methylene fluoride).

B. R-410A, ASHRAE 34: Pentafluoroethane/Difluoromethane.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arkema Inc.
 - b. DuPont Fluorochemicals Div.
 - c. Genetron Refrigerants; Honeywell International Inc.
 - d. Mexichem Fluor, Inc. (Koura).

C. R-454B, ASHRAE 34: R-32/1234yf, blend.

PART 3 EXECUTION

3.1 PIPING APPLICATION SCHEDULES

- A. Refrigerant: R-32, R-410A, or R-454B.
- B. Suction, Hot-Gas, and Liquid Tubing for Conventional Air-Conditioning (Cooling-Only) Applications, 1-1/2 inch and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.
- C. Suction, Hot-Gas, and Liquid Tubing for Conventional Air-Conditioning (Cooling-Only) Applications, 2 to 4 inch: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
- D. Safety-Relief-Valve Discharge Tubing for Conventional Air-Conditioning (Cooling-Only) Applications, Copper: Type ACR, drawn-temper or annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.
- E. Suction, Hot-Gas, and Liquid Tubing for Heat-Pump Applications, 1-1/2 inch and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.
- F. Suction, Hot-Gas, and Liquid Tubing for Heat-Pump Applications, 2 to 4 inch: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
- G. Safety-Relief-Valve Discharge Tubing for Heat-Pump Applications, Copper: Type ACR, drawn-temper or annealed-temper tubing and wrought-copper fittings with brazed or soldered joints

3.2 VALVE AND SPECIALTY APPLICATIONS

- A. Install valve and specialty applications as required by equipment manufacturers.

3.3 INSTALLATION OF PIPING, GENERAL

- A. Install per manufacturers requirements. Equipment manufacturers shall size all piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- C. Install refrigerant piping in accordance with ASHRAE 15.

- 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. Install piping adjacent to machines to allow service and maintenance.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- 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 in accordance with equipment manufacturer requirements.
- P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- Q. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- R. Identify refrigerant piping and valves in accordance with Section 230553 "Identification for HVAC Piping and Equipment."

- S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230500 "Common Work Results for HVAC."
- T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230500 "Common Work Results for HVAC."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230500 "Common Work Results for HVAC."

3.4 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 in accordance with ASTM B828 or CDA's "Copper Tube Handbook."
- D. Brazed Joints: Construct joints in accordance with AWS BRH, "Brazing Handbook," Ch. 35, "Pipe and Tubing."
 - 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.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 ft. long.
 - 2. Roller hangers and spring hangers for individual horizontal runs 20 ft. or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 ft. 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 maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Support horizontal piping within 12 inches of each fitting.
- E. Support vertical runs of copper tubing to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. 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 must maintain test pressure at the manifold gauge 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.
- C. Prepare test and inspection reports.

3.7 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. 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.
4. Charge system with a new filter-dryer core in charging line.

3.8 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 but not 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 23 23 00

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SECTION 23 31 13 - METAL DUCTS

PART 1 GENERAL

1.1 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.

B. Related Requirements:

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.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.

4. Elevation of bottom of ducts.
5. Dimensions of all duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Delegated Design Submittals:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations for selecting hangers and supports.

1.3 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
 1. AWS D1.1, "Structural Welding Code - Steel," for hangers and supports.

2. AWS D1.2, "Structural Welding Code - Aluminum," for aluminum supports.

B. Duct Liner

1. 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. Preference will be given to those who have successfully completed a manufacturer's installation training program.
2. Inspection: A certified mechanical insulation shall be performed by inspectors who maintain current certification, by the National Insulation Association or other certified mechanical association, throughout the project to inspect and verify the materials and the total insulation system has been installed correctly in accordance with the specifications and material manufacturer's instructions.
3. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products listed and labeled in accordance with UL 723 or tested in accordance with 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.
 - a. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - b. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and with performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports are to withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Airstream Surfaces: Surfaces in contact with airstream comply with requirements in ASHRAE 62.1.

- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."
- E. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
- F. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
 - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.
- B. Transverse Joints: Fabricate joints in accordance with 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."
 - 1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
 - 2. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
- C. Longitudinal Seams: Select seam types and fabricate in accordance with 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." All longitudinal seams are to be Pittsburgh lock seams unless otherwise specified for specific application.
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 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," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
1. Construct ducts of galvanized sheet steel unless otherwise indicated.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Linx Industries; a DMI company (formerly Lindab).
 - b. MKT Metal Manufacturing.
 - c. McGill AirFlow LLC.
 - d. SEMCO, LLC; part of FlaktGroup.
 - e. SHAPE Manufacturing Inc.
 - f. Sheet Metal Connectors, Inc.
 - g. Ductmate Industries, Inc; a DMI company.
- B. Source Limitations: Obtain single-wall round ducts and fittings from single manufacturer.
- C. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- D. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.

- E. Tees and Laterals: Select types and fabricate in accordance with 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 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 are to be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A653.
 - 1. Galvanized Coating Designation: G60.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Aluminum Sheets: Comply with ASTM B209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- D. Reinforcement Shapes and Plates: ASTM A36, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- E. Tie Rods: Galvanized steel, 1/4-inch- minimum diameter for lengths 36 inches or less; 3/8-inch- minimum diameter for lengths longer than 36 inches.

2.5 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed; SAINT-GOBAIN.
 - b. Johns Manville; a Berkshire Hathaway company.

- c. Knauf Insulation.
- d. Owens Corning.
- 2. Source Limitations: Obtain fibrous-glass duct liner from single manufacturer.
- 3. Maximum Thermal Conductivity:
 - a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
- 4. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound is to be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
- 5. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C916.

B. Insulation Pins and Washers:

- 1. 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.
- 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place, but not less than 1-1/2 inches in diameter.

C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

- 1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
- 2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
- 3. Butt transverse joints without gaps, and coat joint with adhesive.

4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm or greater.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.
 - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
 - a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.6 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets are to be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with 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: 4 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10 inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.

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, 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.

D. Flanged Joint Sealant: Comply with ASTM C920.

1. General: Single-component, acid-curing, silicone, elastomeric.

2. Type: S.
 3. Grade: NS.
 4. Class: 25.
 5. Use: O.
- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- F. Round Duct Joint O-Ring Seals:
1. Seal is to provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and is to be rated for 10-inch wg static-pressure class, positive or negative.
 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.7 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.
- B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "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 A603.
- D. Steel Cable End Connections: Galvanized-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.

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 in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install ducts in maximum practical lengths with fewest possible joints.
- D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- I. 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.
- J. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.
- K. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

L. Elbows: Use long-radius elbows wherever they fit.

1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
2. Fabricate 90-degree round elbows with a minimum of three segments for 12 inches and smaller and a minimum of five segments for 14 inches and larger.

M. Branch Connections: Use lateral or conical branch connections.

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 arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

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 thick.
 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 DUCTWORK 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.

3.6 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. 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 in accordance with "Description of Method 3 - NADCA 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 is to not exceed 0.75 mg/100 sq. cm.

C. Duct system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.8 STARTUP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.9 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.

B. Supply Ducts:

1. Ducts Connected to Fan Coil Units and Energy Recovery Ventilators:
 - a. Pressure Class: Positive 2- inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 8.
 - d. SMACNA Leakage Class for Round: 4.

C. Return Ducts:

1. Ducts Connected to Fan Coil Units and Energy Recovery Ventilators:
 - a. Pressure Class: Positive or negative 2- inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 8.

- d. SMACNA Leakage Class for Round: 4.

D. Exhaust Ducts:

- 1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 2- inch wg.
 - b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 8.
 - d. SMACNA Leakage Class for Round: 4.

E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

- 1. Ducts Connected to Fan Coil Units and Energy Recovery Ventilators:
 - a. Pressure Class: Positive or negative 2- inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 8.
 - d. SMACNA Leakage Class for Round: 8.

F. Intermediate Reinforcement:

- 1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.
- 2. Stainless Steel Ducts:
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Match duct material.
- 3. Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

G. Liner:

- 1. Supply-Air Ducts: Fibrous glass, Type I, 2 inch thick.
- 2. Return-Air Ducts: Fibrous glass, Type I, 2 inch thick.

3. Exhaust-Air Ducts: Fibrous glass, Type I, 1 inch thick.
4. Supply Fan Plenums: Fibrous glass, Type II, 2 inch thick.
5. Return- and Exhaust-Fan Plenums: Fibrous glass, Type II, 2 inches thick.
6. Transfer Ducts: Fibrous glass, Type I, 1 inch thick.

H. Elbow Configuration:

1. Rectangular Duct - Requirements for Different Velocities: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
2. Rectangular Duct - Requirements for All Velocities: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
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 or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm 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 and Smaller in Diameter: Stamped or pleated.
- c. Round Elbows, 14 Inches and Larger in Diameter: Welded.

I. Branch Configuration:

- 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Conical spin in.
- 2. Round: 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 or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 23 31 13

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SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backdraft dampers.
2. Manual volume dampers.
3. Control dampers.
4. Flange connectors.
5. Turning vanes.
6. Remote damper operators.
7. Duct-mounted access doors.
8. Duct access panel assemblies.
9. Flexible connectors.
10. Duct accessory hardware.

B. Related Requirements:

1. Section 233346 "Flexible Ducts" for insulated and non-insulated flexible ducts.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details, and attachments to other work.

1. Detail duct accessories' fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.

- b. Manual volume damper installations.
- c. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, or BIM model, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from installers of the items involved.
- B. Source quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 90A and NFPA 90B.
- 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 BACKDRAFT DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc. Model CBD6/CD60
 - 2. American Warming and Ventilating (AWV); Mestek, Inc.
 - 3. Cesco Products; MESTEK, Inc.
 - 4. Greenheck Fan Corporation.
 - 5. Nailor Industries Inc.

6. Vent Products Co., Inc.

B. Description: Gravity balanced.

C. Performance:

1. Maximum Air Velocity: 2000 fpm.
2. Maximum System Pressure: 2 inches wg.
3. Leakage:
 - a. Class I: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.

D. Construction:

1. Frame:
 - a. Hat shaped.
 - b. 16-gauge- thick, galvanized sheet steel, with welded or mechanically attached corners and mounting flange.
2. Blades:
 - a. Multiple single-piece blades.
 - b. Center pivoted, maximum 6-inch width, 0.050-inch- thick aluminum sheet with sealed edges.
3. Blade Action: Parallel.

E. Blade Seals: Felt or Neoprene, mechanically locked.

F. Blade Axles:

1. Material: Galvanized steel.
2. Diameter: 0.20 inch.

G. Tie Bars and Brackets: Galvanized steel.

H. Return Spring: Adjustable tension.

- I. Bearings: Steel ball or synthetic pivot bushings.
- J. Accessories:
 - 1. Adjustment device to permit setting for varying differential static pressure.
 - 2. Counterweights and spring-assist kits for vertical airflow installations.
 - 3. Chain pulls.
 - 4. Screen Mounting:
 - a. Rear mounted in sleeve.
 - 1) Sleeve Thickness: 20 gauge minimum.
 - 2) Sleeve Length: 6 inches minimum.
 - 5. Screen Material: Galvanized steel.
 - 6. Screen Type: Bird.
 - 7. 90-degree stops.

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. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc. Model CD36
 - b. Air Balance; MESTEK, Inc.
 - c. American Warming and Ventilating (AWV); Mestek, Inc.
 - d. Arrow United Industries; Mestek, Inc.
 - e. Cesco Products; MESTEK, Inc.
 - f. Greenheck Fan Corporation.
 - g. McGill AirFlow LLC.

- h. Nailor Industries Inc.
 - i. Vent Products Co., Inc.
- 2. Performance:
 - a. Leakage Rating Class III: Leakage not exceeding 40 cfm/sq. ft. against 1-inch wg differential static pressure.
- 3. Construction:
 - a. Linkage out of airstream.
 - b. Suitable for horizontal or vertical airflow applications.
- 4. Frames:
 - a. Hat-shaped, 16-gauge- 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; 16 gauge thick.
- 6. Blade Axles: Galvanized steel.
- 7. Bearings:
 - a. Oil-impregnated bronze.
 - b. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.
- 8. Tie Bars and Brackets: Galvanized steel.
- 9. Locking device to hold damper blades in a fixed position without vibration.

B. Standard, Aluminum, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc. Model CD51
 - b. Air Balance; MESTEK, Inc.
 - c. American Warming and Ventilating (AWV); Mestek, Inc.
 - d. Arrow United Industries; Mestek, Inc.
 - e. Cesco Products; MESTEK, Inc.
 - f. Greenheck Fan Corporation.
 - g. McGill AirFlow LLC.
 - h. Nailor Industries Inc.
 - i. Vent Products Co., Inc.
2. Performance:
 - a. Leakage Rating Class III: Leakage not exceeding 40 cfm/sq. ft. against 1-inch wg differential static pressure.
3. Construction:
 - a. Linkage out of airstream.
 - b. Suitable for horizontal or vertical airflow applications.
4. Frames:
 - a. Hat-shaped, 0.10-inch- thick, aluminum sheet channels.
 - b. 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. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
- 6. Blade Axles: Galvanized steel.
- 7. Bearings:
 - a. Oil-impregnated bronze.
 - b. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.
- 8. Tie Bars and Brackets: Aluminum.
- 9. Locking device to hold damper blades in a fixed position without vibration.

C. Jackshaft:

- 1. Size: 0.5-inch diameter.
- 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
- 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

D. Damper Hardware:

- 1. Zinc-plated, die-cast core with dial and handle, made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
- 2. Include center hole to suit damper operating-rod size.
- 3. Include elevated platform for insulated duct mounting.

2.4 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CL WARD & Family Inc.

2. Ductmate Industries, Inc; a DMI company.
3. DynAir; a Carlisle Company.
4. Elgen Manufacturing.
5. Ward Industries; a brand of Hart & Cooley, LLC.

B. Description: Add-on or roll-formed, factory fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gauge and Shape: Match connecting ductwork.

2.5 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aero-Dyne Sound Control Co.
2. CL WARD & Family Inc.
3. Ductmate Industries, Inc; a DMI company.
4. Duro Dyne Inc.
5. DynAir; a Carlisle Company.
6. Elgen Manufacturing.
7. Ward Industries; a brand of Hart & Cooley, LLC.

B. Manufactured Turning Vanes for Metal Ducts: Fabricate 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. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

D. General Requirements: Comply 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."

E. Vane Construction:

1. Single or double wall.
2. Single wall for ducts up to 48 inches 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. DynAir; a Carlisle Company.
2. METALAIRE, Inc.
3. United Enertech Corp.
4. Young Regulator Company.

B. Description: Cable system designed for remote manual damper adjustment.

C. Tubing: Brass.

D. Cable: Stainless steel.

E. Wall-Box Mounting: Surface.

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. Arrow United Industries; Mestek, Inc.
2. Cesco Products; MESTEK, Inc.
3. Ductmate Industries, Inc; a DMI company.
4. Duro Dyne Inc.

5. Flexmaster U.S.A., Inc.
 6. McGill AirFlow LLC.
 7. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
 8. Ventfabrics, Inc.
 9. Ward Industries; a brand of Hart & Cooley, LLC.
- B. Duct-Mounted Access Doors: Fabricate access panels in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 7-2, "Duct Access Doors and Panels," and Figure 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. 24-gauge- thick galvanized steel or 0.032-inch thick aluminum or 24-gauge-thick stainless steel door panel to match duct construction.
 - d. Vision panel.
 - e. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - f. Fabricate doors airtight and suitable for duct pressure class.
 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 - a. 24-gauge- thick galvanized steel or 0.032-inch- thick aluminum frame.
 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
 - d. Access Doors Larger Than 24 by 48 Inches: Four hinges 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; a DMI company.
 - 2. Duro Dyne Inc.
 - 3. Ventfabrics, Inc.
 - 4. Ward Industries; a brand of Hart & Cooley, LLC.
- B. Fire-Performance Characteristics: Adhesives, sealants, fabric materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested in accordance with ASTM E84.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Materials: Flame-retardant or noncombustible fabrics.
- E. Coatings and Adhesives: Comply with UL 181, Class 1.
- F. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
- G. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd.
 - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 deg F.

2.9 DUCT ACCESSORY HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CL WARD & Family Inc.
 - 2. Ductmate Industries, Inc; a DMI company.

3. Duro Dyne Inc.
 4. DynAir; a Carlisle Company.
 5. Elgen Manufacturing.
 6. Hardcast; Carlisle Construction Materials.
 7. United Enertech Corp.
 8. Ventfabrics, Inc.
 9. Ward Industries; a brand of Hart & Cooley, LLC.
- B. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- C. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.10 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A653.
1. Galvanized Coating Designation: G60.
 2. Exposed-Surface Finish: Mill phosphatized.
- B. Stainless Steel Sheets: Comply with ASTM A480, Type 304, and having a No. 2 finish for concealed ducts and match installed duct finish for exposed ducts.
- C. Aluminum Sheets: Comply with ASTM B209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, one-side bright finish for exposed ducts.
- D. Extruded Aluminum: Comply with ASTM B221, 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 minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install duct accessories in accordance with applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116 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 backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Where multiple damper sections are necessary to achieve required dimensions, provide reinforcement to fully support damper assembly when fully closed at full system design static pressure.
- E. 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.
 - 2. Install aluminum volume dampers in aluminum ducts.
- F. Set dampers to fully open position before testing, adjusting, and balancing.
- G. Install test holes at fan inlets and outlets and elsewhere as indicated and as needed for testing and balancing.
- H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils.
 - 2. Upstream and downstream from duct filters.
 - 3. At outdoor-air intakes and mixed-air plenums.
 - 4. At drain pans and seals.

5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 6. Control devices requiring inspection.
 7. Elsewhere as indicated.
- I. Install access doors with swing against duct static pressure.
- J. Access Door Sizes:
1. One-Hand or Inspection Access: 8 by 5 inches.
 2. Two-Hand Access: 12 by 6 inches.
 3. Head and Hand Access: 18 by 10 inches.
 4. Head and Shoulders Access: 21 by 14 inches.
 5. Body Access: 25 by 14 inches.
 6. Body plus Ladder Access: 25 by 17 inches.
- K. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- L. Install flexible connectors to connect ducts to equipment.
- M. Install duct test holes where required for testing and balancing purposes.

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 size and location of access doors are adequate to perform required operation.
 3. Inspect turning vanes for proper and secure installation, and verify that vanes do not move or rattle.

END OF SECTION 23 33 00

SECTION 23 33 46 - FLEXIBLE DUCTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Flexible ducts, insulated.
2. Flexible duct connectors.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Flexible ducts, insulated.
2. Flexible duct connectors.

B. Product Data Submittals: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings:** Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from installers of the items involved.

PART 2 PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A.** Comply with NFPA 90A and NFPA 90B.
- 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 must be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- C.** Comply with the Air Duct Council's (formerly, Air Diffusion Council) "ADC Flexible Air Duct Test Code - FD 72-R1" and "Flexible Duct Performance & Installation Standards."
- D.** Comply with ASTM E96.

2.2 FLEXIBLE DUCTS, INSULATED

- A. Standard: Product is to be UL 181 listed and bearing the UL label.
- B. Flexible Ducts, Insulated - Class 1, Two-Ply Vinyl Film Supported by Helically Wound, Spring-Steel Wire; Fibrous-Glass Insulation:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ATCO Rubber Products, Inc.
 - b. Flexmaster U.S.A., Inc.
 - c. JP Lamborn Co.
 - d. Thermaflex; a Flex-Tek Group company.
 - 2. Pressure Rating: 10 inch wg positive and 1.0 inch wg negative.
 - 3. Maximum Air Velocity: 4000 fpm.
 - 4. Temperature Range: Minus 10 to plus 160 deg F.
 - 5. Insulation R-Value: R8.
 - 6. Vapor-Barrier Film: Polyethylene.

2.3 FLEXIBLE DUCT CONNECTORS

- A. Clamps: Stainless steel band with stainless steel or zinc-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.
- B. Non-Clamp Connectors: Liquid adhesive plus tape.

PART 3 EXECUTION

3.1 INSTALLATION OF FLEXIBLE DUCTS

- A. Install flexible ducts in accordance with applicable details in the following publications:
 - 1. ADC's "Flexible Duct Performance & Installation Standards" for flexible ducts.
 - 2. NAIMA AH116.

3. SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.
 4. SMACNA's "Fibrous Glass Duct Construction Standards" for fibrous-glass ducts.
- B. Install in indoor applications only. Do not install flexible duct in locations where it will be exposed to UV lighting.
- C. Connect diffusers to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- D. Connect flexible ducts to metal ducts with draw bands.
- E. Installation:
1. Install ducts fully extended.
 2. Do not bend ducts across sharp corners.
 3. Bends of flexible ducting must not exceed a minimum of one-duct diameter.
 4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
 5. Install flexible ducts in a direct line, without sags, twists, or turns.
 6. Install in accordance with ADC instructions.
- F. Supporting Flexible Ducts:
1. Support flexible duct at manufacturer's recommended intervals, but at no greater distance than 4 ft. Provide sufficient support so that maximum centerline sag is 1/2 in. per ft. between supports. A connection to rigid duct or equipment may be considered a support joint.
 2. Install extra supports at bends placed approximately one-duct diameter from center line of the bend.
 3. Ducts may rest on ceiling joists or truss supports. Spacing between supports must not exceed the maximum spacing in accordance with manufacturer's written installation instructions.
 4. Vertically installed ducts must be stabilized by support straps at a maximum of 72 inches o.c.

END OF SECTION 23 33 46

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SECTION 23 37 13.13 - AIR DIFFUSERS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Square ceiling diffusers.
2. Linear slot diffusers.

B. Related Requirements:

1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.
2. Section 233713.23 "Air Registers and Grilles" for adjustable-bar register and grilles, fixed-face registers and grilles, and linear bar grilles.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

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 Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

5. Duct access panels.

- B. Source quality-control reports.

PART 2 PRODUCTS

2.1 SQUARE CEILING DIFFUSERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Anemostat Air Distribution; Anemostat, Inc.; Mestek, Inc.
2. Carnes Company.
3. Krueger-HVAC; brand of Johnson Controls International plc, Global Products.
4. METALAIRE, Inc.
5. Nailor Industries Inc.
6. Price Industries Limited.
7. Titus; brand of Johnson Controls International plc, Global Products.
8. Tuttle & Bailey; brand of Johnson Controls International plc, Global Products.

- B. Type D-1, Titus TMS 24x24

1. Devices shall be specifically designed for variable-air-volume flows.
2. Material: Steel.
3. Finish: Baked enamel, color selected by Architect.
4. Face Size: 24 by 24 inches.
5. Face Style: Three cone.
6. Mounting: As required.
7. Pattern: Fixed 360 degree pattern
8. Dampers: None.

2.2 LINEAR SLOT DIFFUSERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Anemostat Air Distribution; Anemostat, Inc.; Mestek, Inc.
2. Carnes Company.
3. Krueger-HVAC; brand of Johnson Controls International plc, Global Products.
4. METALAIRE, Inc.
5. Nailor Industries Inc.
6. Price Industries Limited.
7. Titus; brand of Johnson Controls International plc, Global Products.
8. Tuttle & Bailey; brand of Johnson Controls International plc, Global Products.

B. Type D-2, Titus FL

1. Devices shall be specifically designed for constant-air-volume flows.
2. Material - Shell: Steel, insulated.
3. Material - Pattern Controller and Tees: Aluminum.
4. Finish - Face and Shell: Baked enamel, black.
5. Finish - Pattern Controller: Baked enamel, black.
6. Finish - Tees: Baked enamel, color selected by Architect.
7. Slot Width: As scheduled on drawings.
8. Number of Slots: As scheduled on drawings.
9. Length: As scheduled on drawings.
10. Insulated Plenum: Insulated plenums shall be designed specifically for field attachment to the linear slot diffuser. Plenums shall include a factory drawn side inlet to fit the slot diffuser of the sizes and mounting types shown on the plans. Length shall match slot. The performance data with the linear slot diffuser and

plenum shall be tested as one assembly in accordance with -ANSI/ASHRAE Standard 70-1991.

11. Plenum Inlet Size: As scheduled on drawings.
12. Plenum End Caps: End caps are not insulated and can be turned up in the field to allow installing continuous lengths beyond the standard maximum length of 6 feet.
13. Border Type: border type shall be continuous including end caps and end border to match frame. Frame and border type shall be either exposed mounting or for lay-in as required for the installed ceiling type.

2.3 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

2.4 CODES AND STANDARDS

- A. ASHRAE Standard 70, Method of Testing the Performance of Air Outlets and Air Inlets, 2006
- B. ASTM Standard E84, Standard Test Method for Surface Burning Characteristics of Building Materials, 2016

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers 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 with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13.13

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SECTION 23 37 13.23 - REGISTERS AND GRILLES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Registers
2. Grilles

B. Related Requirements:

1. Section 233300 "Air Duct Accessories" for volume-control dampers not integral to registers and grilles.
2. Section 233713.13 "Air Diffusers" for various types of air diffusers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

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. Register and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

5. Duct access panels.

- B. Source quality-control reports.

PART 2 PRODUCTS

2.1 REGISTERS

A. Adjustable Blade Face Register – Type R-2, Titus 350

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anemostat Air Distribution; Anemostat, Inc.; Mestek, Inc.
 - b. Carnes Company.
 - c. Krueger-HVAC; brand of Johnson Controls International plc, Global Products.
 - d. METALAIRE, Inc.
 - e. Nailor Industries Inc.
 - f. Price Industries Limited.
 - g. Titus; brand of Johnson Controls International plc, Global Products.
 - h. Tuttle & Bailey; brand of Johnson Controls International plc, Global Products.
2. Material: Steel.
3. Finish: Baked enamel, color selected by Architect.
4. Face Blade Arrangement: Horizontal spaced 3/4 inch apart.
5. Core Construction: Integral.
6. Rear-Blade Arrangement: Horizontal spaced 3/4 inch apart.
7. Frame: 1-1/4 inches wide.
8. Mounting: As required.

9. Damper Type: None.

B. Perforated - Type R-1, Titus PAR

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anemostat Air Distribution; Anemostat, Inc.; Mestek, Inc.
 - b. Carnes Company.
 - c. Hart & Cooley, LLC.
 - d. Krueger-HVAC; brand of Johnson Controls International plc, Global Products.
 - e. METALAIRE, Inc.
 - f. Nailor Industries Inc.
 - g. Price Industries Limited.
 - h. Titus; brand of Johnson Controls International plc, Global Products.
 - i. Tuttle & Bailey; brand of Johnson Controls International plc, Global Products.
2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Steel backpan and pattern controllers, with steel face.
4. Finish: Baked enamel, color selected by Architect.
5. Face Size: 24 by 24 inches.
6. Duct Inlet: As indicated on drawings.
7. Face Style: Flush.
8. Mounting: As required.
9. Pattern Controller: None.
10. Dampers: None.

2.2 GRILLES

A. Perforated - Type G-1, Titus PAR

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anemostat Air Distribution; Anemostat, Inc.; Mestek, Inc.
 - b. Carnes Company.
 - c. Hart & Cooley, LLC.
 - d. Krueger-HVAC; brand of Johnson Controls International plc, Global Products.
 - e. METALAIRE, Inc.
 - f. Nailor Industries Inc.
 - g. Price Industries Limited.
 - h. Titus; brand of Johnson Controls International plc, Global Products.
 - i. Tuttle & Bailey; brand of Johnson Controls International plc, Global Products.
2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Steel backpan and pattern controllers, with steel face.
4. Finish: Baked enamel, color selected by Architect.
5. Face Size: 24 by 24 inches.
6. Duct Inlet: As indicated on drawings.
7. Face Style: Flush.
8. Mounting: As required.
9. Pattern Controller: None.
10. Dampers: None.

2.3 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate registers and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas where registers and grilles are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install registers and grilles level and plumb.
- B. Outlets and Inlets Locations: 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 registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13.23

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SECTION 23 72 23.19 – PACKAGED INDOOR FIXED PLATE ENERGY RECOVERY UNITS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fixed-plate, total heat exchangers in packaged, indoor, energy-recovery units.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include packaged, indoor, fixed-plate, energy-recovery unit rated capacities, operating characteristics, furnished specialties, and accessories.
2. Fans:
 - a. Certified fan-performance curves with system operating conditions indicated.
 - b. Certified fan-sound power ratings.
 - c. Fan construction and accessories.
 - d. Motor ratings, electrical characteristics, and motor accessories.

B. Shop Drawings: For packaged, indoor, fixed-plate, energy-recovery units.

1. Include plans, elevations, sections, details, and mounting 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 diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, elevations, and other details, drawn to scale. and coordinated with each other, using input from installers of the items involved.

B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-to-air energy recovery equipment to include in maintenance manuals.

1.5 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) of each type of filter specified.

1.6 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of packaged, indoor, fixed-plate, energy-recovery units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Packaged Energy-Recovery Units: One Year

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.
- B. ASHRAE Compliance:
 - 1. Applicable requirements in ASHRAE 62.1.
 - 2. Capacity ratings for fixed-plate energy-recovery units shall comply with ASHRAE 84.
- C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1.
- D. UL Compliance:
 - 1. Packaged heat-recovery ventilators shall comply with requirements in UL 1812 or UL 1815.

2. Electric coils shall comply with requirements in UL 1995.

E. Comply with ASTM E84 or UL 723.

2.2 CAPACITIES AND CHARACTERISTICS

A. As scheduled on the drawings.

2.3 PACKAGED, INDOOR, FIXED-PLATE TOTAL ENERGY RECOVERY UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Aldes
2. Daikin.
3. Greenheck.
4. RenewAire LLC.

B. Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Housing: Manufacturer's standard construction with galvanized steel plate. The unit shall be internally insulated with a self-extinguishing urethane foam.

D. Fixed-Plate Total Heat Exchanger:

1. Casing: Galvanized steel.
2. Plates: Evenly spaced and sealed and arranged for cross-flow.
 - a. Plate Material: HEP (high efficiency paper) heat exchanger designed to allow the exchange of both sensible and latent energy between the supply and exhaust airstreams. The core material shall be tested as specified in UL 723 and have a flame spread rating of not more than 25, and a smoke developed rating of not more than 50.

E. Supply and Exhaust Fans: Forward-curved centrifugal.

1. Motor and Drive: Direct driven.

2. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230500 "Common Work Results for HVAC."
3. 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. Filters:

1. The supply and exhaust air streams shall be filtered with MERV-8 filters prior to entering the heat exchanger core by means of a multidirectional fibrous fleece filter.

G. Wiring: Fabricate units with space within housing for electrical conduits. Wire motors and controls, so only external connections are required during installation.

2.4 CONTROLS

- A. Starting relay, factory mounted and wired, and manual motor starter for field wiring.
- B. Low-Voltage Transformer: Integral transformer to provide control voltage to unit from primary incoming electrical service.
- C. The unit shall be controlled through the VRF Central Controller.

2.5 SOURCE QUALITY CONTROL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- B. AHRI Compliance: Capacity ratings for air-to-air energy-recovery equipment certified as complying with AHRI 1060 (AHRI 1061).
- C. Fan Performance Rating: Comply with AMCA 211 and label fans with AMCA-certified rating seal. Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency according to AMCA 210/ASHRAE 51.
- D. Fan Sound Ratings: Comply with AMCA 301 or AHRI 260 (IP). Air-handling unit fan sound ratings shall comply with AMCA 301 or AHRI 260 (IP).
- E. UL Compliance:

1. Packaged fixed plate energy recovery units shall comply with requirements in UL 1812; or UL 1815.
2. Electric Coils: Comply with UL 1995.

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. Examine casing insulation materials and filter media before packaged, indoor, fixed-plate, energy-recovery unit installation. Replace with new insulation materials and filter media that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install packaged, indoor, fixed-plate, energy-recovery units, so supply and exhaust airstreams flow in opposite directions.
 1. Install access doors in both supply and exhaust ducts, both upstream and downstream, for access to interior components.
 2. Install removable panels or access doors between supply and exhaust ducts on building side for bypass during startup.
 3. Access doors and panels are specified in Section 233300 "Air Duct Accessories."
- B. Suspended Units: Suspend units from structural-steel support frame, using threaded steel rods and spring hangers. Comply with requirements for vibration-isolation devices specified in Section 230548 "Vibration Controls for HVAC."
- C. Install units with clearances for service and maintenance.
- D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.

3.3 DUCTWORK CONNECTIONS

- A. Comply with requirements for ductwork according to Section 233113 "Metal Ducts."

- B. Connect duct to units with flexible connections. Comply with requirements in Section 233300 "Air Duct Accessories."
- C. Isolation Dampers: Install isolation dampers according to Section 233300 "Air Duct Accessories."

3.4 PIPING CONNECTIONS

- A. Where installing piping adjacent to unit, allow for service and maintenance.
- B. Connect piping to units mounted on vibration isolators with flexible connectors.

3.5 ELECTRICAL CONNECTIONS

- A. Install electrical devices furnished with units but not factory mounted.
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
- E. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

3.6 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
- B. Tests and Inspections:
 - 1. 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.
- C. Packaged, indoor, fixed-plate, energy-recovery units will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.8 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.

3.9 ADJUSTING

- A. Adjust moving parts to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust initial temperature and humidity setpoints.
- C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-to-air energy-recovery units.

END OF SECTION 23 72 23.19

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SECTION 23 81 29 - VARIABLE-REFRIGERANT-FLOW HVAC SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: VRF HVAC systems.

1. Indoor, concealed, floor-mounted units for ducting.
2. Outdoor, air-source heat-pump units.
3. System controls.
4. System refrigerant and oil.
5. System condensate drain piping.
6. System refrigerant piping.
7. Metal hangers and supports.
8. Metal framing systems.
9. Fastener systems.
10. Pipe stands.
11. Outdoor equipment stands.
12. Miscellaneous support materials.
13. Piping and tubing insulation.
14. System control cable.

1.2 DEFINITIONS

- A. Air-Conditioning System Operation: System capable of operation with all zones in cooling only.
- B. Heat-Pump System Operation: System capable of operation with all zones in either heating or cooling, but not with simultaneous heating and cooling zones that transfer heat between zones.

- C. 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.
- D. Plenum: A space forming part of the air distribution system to which one or more air ducts are connected. An air duct is a passageway, other than a plenum, for transporting air to or from heating, ventilating, or air-conditioning equipment.
- E. VRF: Variable refrigerant flow.

1.3 ACTION SUBMITTALS

A. Product Data: For VRF HVAC system components.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for indoor and outdoor units.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Include operating performance at design conditions and at extreme maximum and minimum outdoor ambient conditions.
4. Include description of system controllers, dimensions, features, control interfaces and connections, power requirements, and connections.
5. Include system operating sequence of operation in narrative form for each unique indoor- and outdoor-unit control.
6. Include description of control software features.
7. Include total refrigerant required and a comprehensive breakdown of refrigerant required by each system installed.
8. Include refrigerant type and data sheets showing compliance with requirements indicated.
9. For system design software.
10. Indicate location and type of service access.

B. Shop Drawings: For VRF HVAC systems.

1. Include plans, elevations, sections, and mounting 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. 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. Include diagrams and details of refrigerant piping and tubing showing installation requirements for manufacturer-furnished divided flow fittings.
5. Include diagrams for power, signal, and control wiring.

C. Delegated Design Submittals:

1. Include design calculations with corresponding diagram of refrigerant piping and tubing sizing for each system installed.
2. Include design calculations with corresponding floor plans indicating that refrigerant concentration limits are within allowable limits of ASHRAE 15 and governing codes.
3. Include calculations showing that system travel distance for refrigerant piping and controls cabling are within horizontal and vertical travel distances set by manufacturer. Provide a comparison table for each system installed.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, elevations, sections, and 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 floors, roofs and associated members to which equipment, piping, ductwork, cables, and conduit will be attached.
3. Size and location of initial access modules for acoustical tile.
4. Wall-mounted controllers located in finished space showing relationship to light switches, fire-alarm devices, and other installed devices.
5. Size and location of access doors and panels installed behind walls and inaccessible ceilings for products installed behind walls and requiring access.

6. Items penetrating finished ceiling including the following:

- a. Luminaires.
- b. Air outlets and inlets.
- c. Speakers.
- d. Sprinklers.
- e. Service access panels.

B. Qualification Data:

- 1. For Installer: Certificate from VRF HVAC system manufacturer certifying that Installer has successfully completed prerequisite training administered by manufacturer for proper installation of systems, including but not limited to, equipment, piping, controls, and accessories indicated and furnished for installation.
 - a. Retain copies of Installer certificates on-site and make available on request.
- 2. For VRF HVAC system manufacturer.
- 3. For VRF HVAC system provider.

C. Product Certificates: For VRF HVAC system components.

D. Product Test Reports: Where tests are required, for each product, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.

E. Source quality-control reports.

F. Field quality-control reports.

G. Sample Warranties: For manufacturer's warranties.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For VRF HVAC systems to include in emergency, operation, and maintenance manuals.

B. Software and Firmware Operational Documentation:

- 1. Software operating and upgrade manuals.

2. Program Software Backup: On CD or DVD, USB media, or approved cloud storage platform, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

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:
 - a. One set(s) for each unit with replaceable filters.
 - b. One set(s) for each unit type and unique size of washable filters.
2. Indoor Units: One for each unique size and type installed.
3. Controllers for Indoor Units: One for each unique controller type installed.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Nationally recognized manufacturer of VRF HVAC systems and products.
2. Shipped VRF HVAC systems with similar requirements to those indicated for a continuous period of 10 years within time of bid.
3. VRF HVAC systems and products that have been successfully tested and in use on at least five completed projects.
4. Having complete published catalog literature, installation, and operation and maintenance manuals for all products intended for use.
5. Having full-time in-house employees for the following:
 - a. Product research and development.
 - b. Product and application engineering.
 - c. Product manufacturing, testing, and quality control.

- d. Technical support for system installation training, startup, commissioning, and troubleshooting of installations.
- e. Owner training.

B. Factory-Authorized Service Representative Qualifications:

- 1. Authorized representative of, and trained by, VRF HVAC system manufacturer.
- 2. In-place facility located within 50 miles of Project.
- 3. Demonstrated past experience with products being installed for period within five consecutive years before time of bid.
- 4. Demonstrated past experience on five projects of similar complexity, scope, and value.
 - a. Each person assigned to Project shall have demonstrated past experience.
- 5. Staffing resources of competent and experienced full-time employees that are assigned to execute work according to schedule.
- 6. Service and maintenance staff assigned to support Project during warranty period.
- 7. Product parts inventory to support ongoing system operation for a period of not less than five years after Substantial Completion.
- 8. VRF HVAC system manufacturer's backing to take over execution of Work if necessary to comply with requirements indicated. Include Project-specific written letter, signed by manufacturer's corporate officer, if requested.

C. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by VRF HVAC system manufacturer.

- 1. Each employee shall be certified by manufacturer for proper installation of systems, including, but not limited to, equipment, piping, 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.

D. ISO Compliance: System equipment and components furnished by VRF HVAC system manufacturer shall be manufactured in an ISO 9001 and ISO 14001 facility.

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. Manufacturer's Warranty: Manufacturer agrees to repair or replace equipment and components that fail(s) in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Faulty operation.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period:
 - a. For Compressor: 10 year(s) from date of Substantial Completion.
 - b. For Parts, Including Controls: 10 year(s) from date of Substantial Completion.
 - c. For Labor: 10 year(s) from date of Substantial Completion.

PART 2 PRODUCTS

2.1 VRF HVAC SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Carrier Global Corporation.
 2. Daikin Applied.
 3. Johnson Controls, Inc. (Hitachi)
 4. LG Electronics USA, Inc.; LG Electronics Inc.
 5. Mitsubishi Electric & Electronics USA, Inc. (Trane)
- B. Source Limitations: Obtain products from single source from single manufacturer including, but not limited to, the following:
 1. Indoor and outdoor units, including accessories.
 2. Controls and software.
 3. Refrigerant isolation valves.
 4. Specialty refrigerant pipe fittings.

2.2 SYSTEM DESCRIPTION

- A. Direct-expansion (DX) VRF HVAC system(s) with variable capacity in response to varying cooling and heating loads. System shall consist of multiple indoor units, outdoor unit(s), piping, controls, and electrical power to make complete operating system(s) complying with requirements indicated.
 1. Two-pipe system design.

2. System(s) operation, heat pump as indicated on Drawings.
 3. Each system with one refrigerant circuit shared by all indoor units connected to system.
- 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. AHRI Compliance: System and equipment performance certified according to AHRI 1230 and products listed in AHRI directory.
- D. ASHRAE Compliance:
1. ASHRAE 15: For safety code for mechanical refrigeration.
 2. ASHRAE 62.1: For indoor air quality.
 3. ASHRAE 135: For control network protocol with remote communication.
 4. ASHRAE/IES 90.1 Compliance: For system and component energy efficiency.
- E. UL Compliance: Comply with UL 1995.

2.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design complete and operational VRF HVAC system(s) complying with requirements indicated.
1. Provide system refrigerant calculations.
 - a. Refrigerant concentration limits shall be within allowable limits of ASHRAE 15 and governing codes.
 - b. Indicate compliance with manufacturer's maximum vertical and horizontal travel distances. Prepare a comparison table for each system showing calculated distances compared to manufacturer's maximum allowed distances.
 2. System Refrigerant Piping and Tubing:
 - a. Arrangement and routing of piping is shown on the drawings. Arrange piping to interconnect indoor units and outdoor unit(s) in compliance with

manufacturer requirements and requirements indicated. Conceal piping above ceilings and behind walls as indicated on the drawings.

- b. Sizing: Size piping system, using a software program acceptable to manufacturer, to provide performance requirements indicated. Consider requirements to accommodate future change requirements.
3. System Controls:
- a. Network arrangement.
 - b. Network interface with other building systems.
 - c. Product selection.
 - d. Sizing.

B. Service Access:

- 1. Provide and document service access requirements.
- 2. Locate equipment, system isolation valves, and other system components that require service and inspection in easily accessible locations. Avoid locations that are difficult to access if possible.
- 3. Where serviceable components are installed behind walls and above inaccessible ceilings, provide finished assembly with access doors or panels to gain access. Properly size the openings to allow for service, removal, and replacement.
- 4. If less than full and unrestricted access is provided, locate components within an 18-inch reach of the finished assembly.
- 5. Where ladder access is required to service elevated components, provide an installation that provides for sufficient access within ladder manufacturer's written instructions for use.
- 6. Comply with OSHA regulations.

C. System Design and Installation Requirements:

- 1. Design and install systems indicated according to manufacturer's recommendations and written instructions.

2. Where manufacturer's requirements differ from requirements indicated, contact Architect for direction. The most stringent requirements should apply unless otherwise directed in writing by Architect.
- D. Isolation of Equipment: Provide isolation valves to isolate each indoor unit and outdoor unit for service, removal, and replacement without interrupting system operation.
- E. System Capacity Ratio: The sum of connected capacity of all indoor units shall be within the following range of outdoor-unit rated capacity:
 1. Not less than 50 percent.
 2. Not more than 130 percent.
 3. Range acceptable to manufacturer.
- F. System Turndown: Stable operation down to 20 percent of outdoor-unit capacity.
- G. System Auto Refrigerant Charge: Each system shall have an automatic refrigerant charge function to ensure the proper amount of refrigerant is installed in system.
- H. Outdoor Conditions:
 1. Suitable for outdoor ambient conditions encountered.
 - a. Design equipment and supports to withstand wind loads of governing code.
 - b. Design equipment and supports to withstand snow and ice loads of governing code.
 - c. Provide corrosion-resistant coating for components and supports where located in coastal or industrial climates that are known to be harmful to materials and finishes.
 2. Maximum System Operating Outdoor Temperature: See Drawings.
 3. Minimum System Operating Outdoor Temperature: See Drawings.
- I. Thermal Movements: Allow for controlled thermal movements from ambient, surface, and system temperature changes.
- J. Capacities and Characteristics: As indicated on Drawings.

2.4 INDOOR, CONCEALED, FLOOR-MOUNTED UNITS FOR DUCTING

A. Description: Factory-assembled complete unit with components, piping, wiring, and controls required for mating to ductwork, piping, power, and controls field connections.

B. Cabinet:

1. Material: Galvanized or painted steel.
2. Insulation: Manufacturer's standard internal insulation, complying with ASHRAE 62.1, to provide thermal resistance and prevent condensation.
3. Duct Connections: Extended collar or flange, or designated exterior cabinet surface, designed for attaching field-installed ductwork.
4. Mounting: Manufacturer-designed provisions for field installation.
5. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

C. DX Coil Assembly:

1. Coil Casing: Aluminum, galvanized, or stainless steel.
2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
3. Coil Tubes: Copper, of diameter and thickness required by performance.
4. Expansion Valve: Electronic modulating type with linear or proportional characteristics.
5. Unit Internal Tubing: Copper tubing with brazed joints.
6. Unit Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
7. Field Piping Connections: Manufacturer's standard.
8. Factory Charge: Dehydrated air or nitrogen.
9. Testing: Factory pressure tested and verified to be without leaks.

D. Drain Assembly:

1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
2. Condensate Removal: Unit-mounted pump or other integral lifting mechanism, capable of lifting drain water to an elevation above top of cabinet.
3. Field Piping Connection: as required for connected piping specified elsewhere.

E. Fan and Motor Assembly:

1. Fan(s):
 - a. Direct-drive arrangement.
 - b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
 - c. Materials: Non-ferrous components or ferrous components with corrosion resistant finish.
 - d. Statically and dynamically balanced.
2. Motor: Brushless dc or electronically commutated with permanently lubricated bearings.
3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
4. Speed Settings and Control: Two (low, high), three (low, medium, high), or more than three speed settings or variable speed with a speed range of least 50 percent.
5. Vibration Control: Integral isolation to dampen vibration transmission.

F. Filter Assembly:

1. Access: Bottom, side, or rear to accommodate field installation without removing ductwork and to accommodate filter replacement without need for tools.
2. Efficiency: ASHRAE 52.2, MERV 7.
3. Media:
 - a. Replaceable: Extended surface, panel, or cartridge with antimicrobial treatment fiber media.

G. Unit Controls:

1. Enclosure: Metal, suitable for indoor locations.
2. Factory-Installed Controller: Configurable digital control.
3. Field-Customizable I/O Capability:
 - a. Analog Inputs: Two for use in customizable control strategies.
 - b. Digital Inputs: Two for use in customizable control strategies.
 - c. Digital Outputs: Two for use in customizable control strategies.
4. Features and Functions:
 - a. Self-diagnostics.
 - b. Time delay, auto-restart.
 - c. External static pressure control.
 - d. Auto operation mode.
 - e. Manual operation mode.
 - f. Filter service notification.
 - g. Power consumption display.
 - h. Drain assembly high water level safety shutdown and notification.
 - i. Run test switch.
5. Communication: Network communication with other indoor units and outdoor unit(s).
6. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
7. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.

H. Unit Electrical:

1. Enclosure: Metal, similar to enclosure, and suitable for indoor locations.

2. Field Connection: Single point connection to power unit and integral controls.
3. Disconnecting Means: Factory-mounted circuit breaker or switch.
4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Raceways: Enclose line voltage wiring in raceways.

2.5 OUTDOOR, AIR-SOURCE HEAT-PUMP UNITS

A. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.

1. Specially designed for use in systems with either all heating or all cooling demands, but not for use in systems with simultaneous heating and cooling.
2. Systems shall consist of one unit, or multiple unit modules that are designed by variable refrigerant system manufacturer for field interconnection to make a single refrigeration circuit that connects multiple indoor units.
3. All units installed shall be from the same product development generation.

B. Cabinet:

1. Galvanized steel and coated with a corrosion-resistant finish.
 - a. Coating with documented salt spray test performance of 1000 hours according ASTM B117 surface scratch test (SST) procedure.
2. Mounting: Manufacturer-designed provisions for field installation.
3. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

C. Compressor and Motor Assembly:

1. One or more positive-displacement, direct-drive and hermetically sealed scroll compressor(s) with inverter drive and turndown to 15 percent of rated capacity.
2. Protection: Integral protection against the following:

- a. High refrigerant pressure.
 - b. Low oil level.
 - c. High oil temperature.
 - d. Thermal and overload.
 - e. Voltage fluctuations.
 - f. Phase failure and phase reversal.
 - g. Short cycling.
3. Speed Control: Variable to automatically maintain refrigerant suction and condensing pressures while varying refrigerant flow to satisfy system cooling and heating loads.
4. Vibration Control: Integral isolation to dampen vibration transmission.
5. Oil management system to ensure safe and proper lubrication over entire operating range.
6. Crankcase heaters with integral control to maintain safe operating temperature.
7. Fusible plug.

D. Condenser Coil Assembly:

1. Plate Fin Coils:
 - a. Casing: Aluminum, galvanized, or stainless steel.
 - b. Fins: Aluminum or copper, mechanically bonded to tubes, with arrangement required by performance.
 - c. Tubes: Copper, of diameter and thickness required by performance.
2. Aluminum Microchannel Coils:
 - a. Series of flat tubes containing a series of multiple, parallel-flow microchannels layered between refrigerant header manifolds.
 - b. Single- or multiple-pass arrangement.

- c. Construct fins, tubes, and header manifolds of aluminum alloy.
- 3. Coating: Corrosion resistant.
- 4. Hail Protection: Provide condenser coils with louvers, baffles, or hoods to protect against hail damage.
- E. Condenser Fan and Motor Assembly:
 - 1. Fan(s): Propeller type.
 - a. Direct-drive arrangement.
 - b. Fabricated from non-ferrous components or ferrous components with corrosion protection finish to match performance indicated for condenser coil.
 - c. Statically and dynamically balanced.
 - 2. Fan Guards: Removable safety guards complying with OSHA regulations. If using metal materials, coat with corrosion-resistant coating to match performance indicated for condenser coil.
 - 3. Motor(s): Brushless dc or electronically commutated with permanently lubricated bearings and rated for outdoor duty.
 - 4. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
 - 5. Speed Settings and Control: Variable speed with a speed range of least 75 percent.
 - 6. Vibration Control: Integral isolation to dampen vibration transmission.
- F. Drain Pan: If required by manufacturer's design, provide unit with non-ferrous drain pan with bottom sloped to a low point drain connection.
- G. Unit Controls:
 - 1. Enclosure: Manufacturer's standard, and suitable for unprotected outdoor locations.
 - 2. Factory-Installed Controller: Configurable digital control.
 - 3. Factory-Installed Sensors:

- a. Refrigerant suction temperature.
 - b. Refrigerant discharge temperature.
 - c. Outdoor air temperature.
 - d. Refrigerant high pressure.
 - e. Refrigerant low pressure.
 - f. Oil level.
4. Features and Functions: Self-diagnostics, time delay, auto-restart, fuse protection, auto operation mode, manual operation mode, night setback control, power consumption display, run test switch, equalize run time between multiple same components.
 5. Communication: Network communication with indoor units and other outdoor unit(s).
 6. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
 7. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.

H. Unit Electrical:

1. Enclosure: Metal, similar to enclosure, and suitable for unprotected outdoor locations.
2. Field Connection: Single point connection to power entire unit and integral controls.
3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Raceways: Enclose line voltage wiring in raceways to comply with NFPA 70.

- I. Unit Hardware: Zinc-plated steel, or stainless steel. Coat exposed surfaces with additional corrosion-resistant coating if required to prevent corrosion when exposed to salt spray test for 1000 hours according ASTM B117.
- J. Unit Piping:
 - 1. Unit Tubing: Copper tubing with brazed joints.
 - 2. Unit Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
 - 3. Field Piping Connections: Manufacturer's standard.
 - 4. Factory Charge: Dehydrated air or nitrogen.
 - 5. Testing: Factory pressure tested and verified to be without leaks.

2.6 SYSTEM CONTROLS

A. General Requirements:

- 1. Network: Indoor units and outdoor units shall include integral controls and connect through a manufacturer-selected control network.
- 2. Network Communication Protocol: Manufacturer proprietary control communication between interconnected units.
- 3. Operator Interface:
 - a. Operators shall interface with system and unit controls through the following:
 - 1) Operator interfaces integral to controllers.
 - 2) Owner-furnished PC connected to central controller(s).
 - 3) Web interface through web browser software.
 - b. Users shall be capable of interface with controllers for indoor units control to extent privileges are enabled. Control features available to users shall include the following:
 - 1) On/off control.
 - 2) Temperature set-point adjustment.

B. Central Controllers:

1. Centralized control for all indoor and outdoor units from a single central controller location.
 - a. Include multiple interconnected controllers as required.
2. Controls operation mode of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units. Operation modes available through central controller shall match those operation modes of controllers for indoor units.
3. Schedule operation of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units.
 - a. Sets schedule for daily, weekly, and annual events.
 - b. Schedule options available through central controller shall at least include the schedule options of controllers for indoor units.
4. Changes operating set points of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units.
5. Optimized start feature to start indoor units before scheduled time to reach temperature set-point at scheduled time based on operating history.
6. Night setback feature to operate indoor units at energy-conserving heating and cooling temperature set-points during unoccupied periods.
7. Service diagnostics tool.
8. Able to disable and enable operation of individual controllers for indoor units.
9. Information displayed on individual controllers shall also be available for display through central controller.
10. Information displayed for outdoor units, including refrigerant high and low pressures.
11. Multiple RJ-45 ports for direct connection to a local PC and an Ethernet network switch.
12. Operator interface through a backlit, high-resolution color display touch panel and web accessible through standard web browser software.

C. Wired Controllers for Indoor Units:

1. Single controller capable of controlling multiple indoor units as group.
2. Auto Timeout Touch Screen LCD: Timeout duration shall be adjustable.
3. Multiple Language: English.
4. Temperature Units: Fahrenheit and Celsius.
5. On/Off: Turns indoor unit on or off.
6. Hold: Hold operation settings until hold is released.
7. Operation Mode: Cool, Heat, Auto, Dehumidification, Fan Only, and Setback.
8. Temperature Display: 1-degree increments.
9. Temperature Set-Point: Separate set points for Cooling, Heating, and Setback. Adjustable in 1-degree increments.
10. Relative Humidity Display: 1 percent increments.
11. Relative Humidity Set-Point: Adjustable in 1 percent increments between.
12. Fan Speed Setting: Select between available options furnished with the unit.
13. Airflow Direction Setting: If applicable to unit, select between available options furnished with the unit.
14. Seven-day programmable operating schedule with up to five events per day. Operations shall include On/Off, Operation Mode, and Temperature Set-Point.
15. Auto Off Timer: Operates unit for an adjustable time duration and then turns unit off.
16. Occupancy detection.
17. Service Notification Display: "Filter".
18. Service Run Tests: Limit use by service personnel to troubleshoot operation.
19. Error Code Notification Display: Used by service personnel to troubleshoot abnormal operation and equipment failure.

20. User and Service Passwords: Capable of preventing adjustments by unauthorized users.
21. Setting stored in nonvolatile memory to ensure that settings are not lost if power is lost. Battery backup for date and time only.
22. Low-voltage power required for controller shall be powered through non-polar connections to indoor unit.

2.7 SYSTEM REFRIGERANT AND OIL

A. Refrigerant:

1. As required by VRF HVAC system manufacturer for system to comply with performance requirements indicated.
2. ASHRAE 34, Class A1 refrigerant classification.
3. R-32, R-410a, or R-454B.

B. Oil:

1. As required by VRF HVAC system manufacturer and to comply with performance requirements indicated.

2.8 SYSTEM CONDENSATE DRAIN PIPING

- ### A. Comply with requirements in Section 221414 "Storm Drainage Piping" for system piping requirements.

2.9 SYSTEM REFRIGERANT PIPING

- ### A. Comply with requirements in Section 232300 "Refrigerant Piping" for system piping requirements.

- ### B. Divided-Flow Specialty Fittings: Where required by VRF HVAC system manufacturer for proper system operation, VRF HVAC system manufacturer shall furnish specialty fittings with identification and instructions for proper installation by Installer.

C. Refrigerant Isolation Ball Valves:

1. Description: Uni-body full port design, rated for maximum system temperature and pressure, and factory tested under pressure to ensure tight shutoff. Designed for valve operation without removing seal cap.

2. Seals: Compatible with system refrigerant and oil. Seal service life of at least 20 years.
3. Valve Connections: Flare or sweat depending on size.

2.10 METAL HANGERS AND SUPPORTS

- A. Comply with requirement in Section 230529 “Hangers and Supports for HVAC Piping and Equipment.”

2.11 FASTENER SYSTEMS

- A. Comply with requirement in Section 230529 “Hangers and Supports for HVAC Piping and Equipment.”

2.12 PIPE STANDS

- A. Comply with requirement in Section 230529 “Hangers and Supports for HVAC Piping and Equipment.”

2.13 OUTDOOR EQUIPMENT STANDS

- A. Comply with requirement in Section 230529 “Hangers and Supports for HVAC Piping and Equipment.”

2.14 PIPING AND TUBING INSULATION

- A. Comply with requirements in Section 230719 "HVAC Piping Insulation" for system piping insulation requirements.
- B. Comply with requirements in Section 220719 “Plumbing Piping Insulation” for condensate drain piping insulation requirements:

2.15 SYSTEM CONTROL CABLE

- A. Cable Rating: Listed and labeled for application according to NFPA 70.
 1. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262, by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.
 - a. Flame Travel Distance: 60 inches or less.
 - b. Peak Optical Smoke Density: 0.5 or less.

- c. Average Optical Smoke Density: 0.15 or less.
- 2. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.
- 3. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.

B. Low-Voltage Control Cabling:

- 1. Paired Cable: NFPA 70, Type CMG.
 - a. One pair, twisted, No. 16 AWG, stranded (19x29) or No. 18 AWG, stranded (19x30) tinned-copper conductors as required by VRF HVAC system manufacturer.
 - b. PVC insulation.
 - c. Braided or foil shielded.
 - d. PVC jacket.
 - e. Flame Resistance: Comply with UL 1685.
- 2. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
 - a. One pair, twisted, No. 16 AWG, stranded (19x29) or No. 18 AWG, stranded (19x30) tinned-copper conductors as required by VRF HVAC system manufacturer.
 - b. PVC insulation.
 - c. Braided or foil shielded.
 - d. PVC jacket.
 - e. NFPA 262 includes the standard flame-resistance test criteria in common use for cables and conductors.
 - f. Flame Resistance: Comply with NFPA 262.

C. TIA-485A Network Cabling:

- 1. Standard Cable: NFPA 70, Type CMG.

- a. Paired, one pair, twisted, No. 22 AWG, stranded (7x30) tinned-copper conductors.
 - b. PVC insulation.
 - c. Unshielded.
 - d. PVC jacket.
 - e. Flame Resistance: Comply with UL 1685.
- 2. Plenum-Rated Cable: NFPA 70, Type CMP.
 - a. Paired, one pair, No. 22 AWG, stranded (7x30) tinned-copper conductors.
 - b. Fluorinated ethylene propylene insulation.
 - c. Unshielded.
 - d. Fluorinated ethylene propylene jacket.
 - e. NFPA 262 includes the standard flame-resistance test criteria in common use for cables and conductors.
 - f. Flame Resistance: NFPA 262.
- D. Ethernet Network Cabling: TIA-568-C.2 Category 6 cable with RJ-45 connectors.
 - 1. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of category cable indicated.
 - 2. Conductors: 100-ohm, 23 AWG solid copper.
 - 3. Shielding: Unshielded twisted pairs (UTP).
 - 4. Cable Rating: By application.
 - 5. Jacket: White thermoplastic.
- E. Comply with requirements in Section 260533.13 "Conduits for Electrical Systems" for cable raceways.

2.16 MATERIALS

A. Steel:

1. ASTM A36 for carbon structural steel.

2. ASTM A568 for steel sheet.

B. Stainless Steel:

1. Manufacturer's standard grade for casing.

2. Manufacturer's standard type, ASTM A240 for bare steel exposed to airstream or moisture.

C. Galvanized Steel: ASTM A653.

D. Aluminum: ASTM B209.

E. Corrosion-Resistant Coating: Coat with a corrosion-resistant coating capable of withstanding a 3000-hour salt-spray test according to ASTM B117.

1. Standards:

- a. ASTM B117 for salt spray.

- b. ASTM D2794 for minimum impact resistance of 100 in-lb.

- c. ASTM B3359 for cross-hatch adhesion of 5B.

2. Application: Immersion.

3. Thickness: 1 mil.

4. Gloss: Minimum gloss of 60 on a 60-degree meter.

2.17 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect factory-assembled equipment.

B. Equipment will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports for historical record. Submit reports only if requested.

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 products before installation. Reject products that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for piping and tubing to verify actual locations of connections before equipment installation.
- D. Examine roughing-in for ductwork to verify actual locations of connections before equipment installation.
- E. Examine roughing-in for wiring and conduit to verify actual locations of connections before equipment installation.
- F. Examine walls, floors, roofs, and outdoor pads for suitable conditions where equipment will be installed.
- G. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- H. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION, GENERAL

- A. Clearance:
 - 1. Maintain manufacturer's recommended clearances for service and maintenance.
 - 2. Maintain clearances required by governing code.
- B. Loose Components: Install components, devices, and accessories furnished by manufacturer, with equipment, that are not factory mounted.
 - 1. Loose components shall be installed by manufacturer's service representative or system Installer under supervision of manufacturer's service representative.

3.3 INSTALLATION OF INDOOR UNITS

- A. Install units to be level and plumb while providing a neat and finished appearance.

- B. Unless otherwise required by VRF HVAC system manufacturer, support ceiling-mounted units from structure above using threaded rods; minimum rod size of 3/8 inch.
- C. Adjust supports of exposed and recessed units to draw units tight to adjoining surfaces.
- D. Protect finished surfaces of ceilings, floors, and walls that come in direct contact with units. Refinish or replaced damaged areas after units are installed.
- E. In rooms with ceilings, conceal piping and tubing, controls, and electrical power serving units above ceilings.
- F. In rooms without ceiling, arrange piping and tubing, controls, and electrical power serving units to provide a neat and finished appearance.
- G. Provide lateral bracing if needed to limit movement of suspended units to not more than 0.25 inch.
- H. For floor- and wall-mounted units that are exposed, conceal piping and tubing, controls, and electrical power serving units within walls.
- I. Floor-mounted units located in mechanical rooms.
- J. Provide a liquid level sensor in each drain pan.
- K. Install floor-mounted units on support structure indicated on Drawings.
- L. Install floor-mounted units on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
- M. Attachment: Install hardware for proper attachment to supported equipment.
- N. Grouting: Place grout under equipment supports and make bearing surface smooth.

3.4 INSTALLATION OF OUTDOOR UNITS

- A. Install units to be level and plumb while providing a neat and finished appearance.
- B. Install outdoor units on support structures indicated on Drawings.
- C. Pad-Mounted Installations: Install outdoor units on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."

1. Attachment: Install anchor bolts to elevations required for proper attachment to supported equipment.
2. Grouting: Place grout under equipment supports and make bearing surface smooth.

3.5 GENERAL REQUIREMENTS FOR PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping and tubing systems. Install piping and tubing as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping and tubing in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping and tubing at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping and tubing above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping and tubing to permit valve servicing.
- F. Install piping and tubing at indicated slopes.
- G. Install piping and tubing free of sags.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping and tubing to allow application of insulation.
- J. Install groups of pipes and tubing parallel to each other, spaced to permit applying insulation with service access between insulated piping and tubing.
- K. Install sleeves for piping and tubing penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230500 "Common Work Results for HVAC."
- L. Install escutcheons for piping and tubing penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230500 "Escutcheons for HVAC Piping."

3.6 INSTALLATION OF SYSTEM CONDENSATE DRAIN PIPING

- A. General Requirements for Drain Piping and Tubing:

1. Install a union in piping at each threaded unit connection.
2. Install an adjustable stainless steel hose clamp with adjustable gear operator on unit hose connections. Tighten clamp to provide a leak-free installation.
3. If required for unit installation, provide a trap assembly in drain piping to prevent air circulated through unit from passing through drain piping. Comply with more stringent of the following:
 - a. Details indicated on Drawings.
 - b. Manufacturer's requirements.
4. Extend drain piping from units with drain connections to drain receptors as indicated on Drawings. If not indicated on Drawings, terminate drain connection at nearest accessible location that is not exposed to view by occupants.
5. Provide each 90-degree change in direction with a Y- or T-fitting. Install a threaded plug connection in the dormant side of fitting or future use as a service cleanout.

B. Gravity Drains:

1. Slope piping from unit connection toward drain termination at a constant slope of not less than two percent.

C. Pumped Drains:

1. If unit condensate pump or lift mechanism is not included with an integral check valve, install a full-size check valve in each branch pipe near unit connection to prevent backflow into unit.

3.7 INSTALLATION OF REFRIGERANT PIPING

A. Refrigerant Tubing Kits:

1. Unroll and straighten tubing to suit installation. Deviations in straightness of exposed tubing shall be unnoticeable to observer.
2. Support tubing using hangers and supports indicated at intervals not to exceed 5 feet. Minimum rod size, 1/4 inch.
3. Prepare tubing ends and make mating connections to provide a pressure tight and leak-free installation.

- B. Install refrigerant piping according to ASHRAE 15 and governing codes.
- C. Select system components with pressure rating equal to or greater than system operating pressure.
- D. Install piping as short and direct as possible, with a minimum number of joints and fittings.
- E. Arrange piping to allow inspection and service of 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.
- F. Install refrigerant piping and tubing in protective conduit where installed belowground.
- G. Install refrigerant piping and tubing in rigid or flexible conduit in locations where exposed to mechanical damage.
- H. Unless otherwise required by VRF HVAC system manufacturer, slope refrigerant piping and tubing as follows:
 - 1. Install horizontal hot-gas discharge piping and tubing with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
- I. When brazing, remove or protect components that could be damaged by heat.
- J. Before installation, clean piping, tubing, and fittings to cleanliness level required by VRF HVAC system manufacturer.
- K. Comply with requirements as specified in Section 232300 "Refrigerant Piping."

3.8 INSTALLATION OF METAL HANGERS AND SUPPORTS

- A. Comply with requirements specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment and Section 220529 "Hangers and Support for Plumbing Piping and Equipment."

3.9 INSTALLATION OF PIPING AND TUBING INSULATION

- A. Comply with requirements as specified in Section 230719 "HVAC Piping Insulation" and Section 220719 "Plumbing Piping Insulation."

3.10 INSTALLATION OF DUCT, ACCESSORIES, AND AIR OUTLETS

- A. Where installing ductwork adjacent to equipment, allow space for service and maintenance.
- B. Comply with requirements for metal ducts specified in Section 233113 "Metal Ducts."
- C. Comply with requirements for air duct accessories specified in Section 233300 "Air Duct Accessories."
- D. Comply with requirements for flexible ducts specified in Section 233346 "Flexible Ducts."
- E. Comply with requirements for air diffusers specified in Section 233713.13 "Air Diffusers."
- F. Comply with requirements for registers and grilles specified in Section 233713.23 "Registers and Grilles."

3.11 ELECTRICAL CONNECTIONS

- A. Comply with requirements indicated on Drawings and in applicable Division 26 Sections.
- B. To extent electrical power is required for system equipment, components, and controls, and is not indicated on Drawings and addressed in the Specifications, the design for such electrical power shall be delegated to VRF HVAC system provider.
 - 1. Delegated design of electrical power to equipment, components and controls, and associated installation shall be included at no additional cost to Owner.
- C. Connect field electrical power source to each separate electrical device requiring field electrical power. Coordinate termination point and connection type with Installer.
- D. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.
- E. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding connections.

- F. Install nameplate or acrylic label with self-adhesive back for each electrical connection indicating electrical equipment designation and circuit number feeding connection.
 - 1. Nameplate shall be laminated phenolic layers of black with engraved white letters. Letters at least 1/2 inch high.
 - 2. Locate nameplate or label where easily visible.
- G. Comply with requirements in Section 260533.13 "Conduits for Electrical Systems" for raceway selection and installation requirements for conduits as supplemented or revised in this Section.
- H. Comply with requirements in Section 260533.16 "Boxes and Covers for Electrical Systems" for box selection and installation requirements for boxes as supplemented or revised in this Section.
- I. Comply with requirements in Section 260533.23 "Surface Raceways for Electrical Systems" for wireways selection and installation requirements for wireways as supplemented or revised in this Section.
 - 1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.
 - 2. Outlet boxes for cables shall be no smaller than 4 inches square by 1-1/2 inches deep with extension ring sized to bring edge of ring to within 1/8 inch of the finished wall surface.
 - 3. Flexible metal conduit shall not be used.
- J. Comply with TIA-569-D for pull-box sizing and length of conduit and number of bends between pull points.
- K. Install manufactured conduit sweeps and long-radius elbows if possible.
- L. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

3.12 INSTALLATION OF SYSTEM CONTROL CABLE

- A. Comply with NECA 1.
- B. Installation Method:
 - 1. Install cables in raceways except as follows:

- a. Within equipment and associated control enclosures.
 - b. In accessible ceiling spaces where open cable installation method may be used.
 - c. In gypsum board partitions where cable may be enclosed within wall cavity.
2. Conceal raceway and cables except in unfinished spaces.

C. General Requirements for Cabling:

1. Comply with TIA-568-C Series of standards.
2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems."
3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
4. Cables may not be spliced and shall be continuous from terminal to terminal. Do not splice cable.
5. Cables serving a common system may be grouped in a common raceway. Install control cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
6. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Install lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.
9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.
10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Monitor cable pull tensions.
11. Support: Do not allow cables to lie on removable ceiling tiles or access panels.

12. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
13. Provide strain relief.
14. Keep runs short. Allow extra length for connecting to terminals.
15. Do not bend cables in a radius less than 10 times the cable OD.
16. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
17. Ground wire shall be copper, and grounding methods shall comply with IEEE C2. Demonstrate ground resistance.

D. Balanced Twisted-Pair Cable Installation:

1. Comply with TIA-568-C.2.
2. Do not untwist balanced twisted-pair cables more than 1/2 inch at the point of termination to maintain cable geometry.

E. Open-Cable Installation:

1. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 30 inches apart.
2. Cable shall not be run through or on structural members or in contact with pipes, ducts, or other potentially damaging items. Do not run cables between structural members and corrugated panels.

F. Separation from EMI Sources: Comply with BICSI TDMM and TIA-569-D recommendations for separating unshielded cable from potential EMI sources including electrical power wiring and equipment.

3.13 FIRESTOPPING

- A. Comply with TIA-569-D, Annex A, "Firestopping."
- B. Comply with BICSI TDMM, "Firestopping" Chapter.

3.14 GROUNDING INSTALLATION

- A. For data communication wiring, comply with TIA-607-B and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.

- B. For low-voltage control cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.15 IDENTIFICATION

- A. Identify system equipment, piping, tubing, and valves. Comply with requirements for identification specified in Section 230553 "Identification for HVAC Piping and Equipment."
- B. Identify system electrical and controls components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
 - 1. Identify each control cable on each end and at each terminal with a number-coded identification tag. Each cable shall have a unique tag.

3.16 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage VRF HVAC system manufacturer's service representative to advise and assist installers; witness testing; and observe and inspect components, assemblies, and equipment installations, including controls and connections.
 - 1. Field service shall be performed by a factory-trained and -authorized service representative of VRF HVAC system manufacturer whose primary job responsibilities are to provide direct technical support of its products.
 - 2. Manufacturer shall provide on-site visits during the course of construction at installation milestones indicated. System Installer shall coordinate each visit in advance to give manufacturer sufficient notice to plan the visit.
 - a. First Visit: Kick-off meeting.
 - b. Second Visit: At approximately 25 percent completion of system(s).
 - c. Third Visit: At approximately 50 percent completion of system(s).
 - d. Fourth Visit: At approximately 75 percent completion of system(s).
 - e. Fifth Visit: Final inspection before system startup.
 - 3. Kick-off Meeting:

- a. Meeting shall include system Installer and other related trades with sole purpose of reviewing VRF HVAC system installation requirements and close coordination required to make a successful installation.
- b. Meeting shall be held at Project site and scheduled at a mutually agreed to time that occurs before the start of any part of system installation.
- c. Meeting shall cover the following as a minimum requirement:
 - 1) Review of latest issue of Contract Documents, Drawings, and Specifications, relevant to VRF HVAC systems.
 - 2) Manufacturer's installation requirements specific to systems being installed.
 - 3) Review of all relevant VRF HVAC system submittals, including delegated design submittals.
 - 4) Required field activities related installation of VRF HVAC system.
 - 5) Project team communication protocol, contact information, and exchange of responsibilities for each party involved, including manufacturer, supplier, system Installer, and other related trades.
- 4. Site Visits: Activities for each site visit shall include the following:
 - a. Meet with VRF HVAC system Installer to discuss field activities, issues, and suggested methods to result in a successful installation.
 - b. Offer technical support to Installer and related trades as related to VRF system(s) being installed.
 - c. Review progress of VRF HVAC system(s) installation for strict compliance with manufacturer's requirements.
 - d. Advise and if necessary assist Installer with updating related refrigerant calculations and system documentation.
 - e. Issue a report for each visit, documenting the visit.
 - 1) Report to include name and contact information of individual making the visit.
 - 2) Date(s) and time frames while on-site.

- 3) Names and contact information of people meeting with while on-site.
 - 4) Clearly identify and list each separate issue that requires resolution. For each issue, provide a unique identification number, relevant importance, specific location or equipment identification, description of issue, recommended corrective action, and follow-up requirements needed. Include a digital photo for clarification if deemed to be beneficial.
5. Final Inspection before Startup:
- a. Before inspection, Installer to provide written request to manufacturer stating the system is fully installed according manufacturer's requirements and ready for final inspection.
 - b. All system equipment and operating components shall be inspected. If components are inaccessible for inspection, they shall be made accessible before the final inspection can be completed.
 - c. Manufacturer shall provide a comprehensive inspection of all equipment and each operating component that comprise the complete system(s). Inspection shall follow a detailed checklist specific to each equipment and operating component.
 - d. Inspection reports for indoor units shall include, but not be limited to, the following:
 - 1) Unit designation on Drawings.
 - 2) Manufacturer model number.
 - 3) Serial number.
 - 4) Network address, if applicable.
 - 5) Each equipment setting.
 - 6) Mounting, supports, and restraints properly installed.
 - 7) Proper service clearance provided.
 - 8) Wiring and power connections correct.
 - 9) Line-voltage reading(s) within acceptable range.

- 10) Wiring and controls connections correct.
 - 11) Low-voltage reading(s) within an acceptable range.
 - 12) Controller type and model controlling unit.
 - 13) Controller location.
 - 14) Temperature settings and readings within an acceptable range.
 - 15) Humidity settings and readings within an acceptable range.
 - 16) Condensate removal acceptable.
 - 17) Fan settings and readings within an acceptable range.
 - 18) Unit airflow direction within an acceptable range.
 - 19) If applicable, fan external static pressure setting.
 - 20) Filter type and condition acceptable.
 - 21) Noise level within an acceptable range.
 - 22) Refrigerant piping properly connected and insulated.
 - 23) Condensate drain piping properly connected and insulated.
 - 24) If applicable, ductwork properly connected.
 - 25) If applicable, external interlocks properly connected.
 - 26) Remarks.
- e. Inspection reports for outdoor units shall include, but not be limited to, the following:
- 1) Unit designation on Drawings.
 - 2) Manufacturer model number.
 - 3) Serial number.
 - 4) Network address, if applicable.

- 5) Each equipment setting.
- 6) Mounting, supports, and restraints properly installed.
- 7) Proper service clearance provided.
- 8) Wiring and power connections correct.
- 9) Line-voltage reading(s) within acceptable range.
- 10) Wiring and controls connections correct.
- 11) Low-voltage reading(s) within an acceptable range.
- 12) Condensate removal acceptable.
- 13) Noise level within an acceptable range.
- 14) Refrigerant piping properly connected and insulated.
- 15) Condensate drain piping properly connected and insulated.
- 16) Remarks.

- f. Installer shall provide manufacturer with the requested documentation and technical support during inspection.
- g. Installer shall correct observed deficiencies found by the inspection.
- h. Upon completing the on-site inspection, manufacturer shall provide a written report with complete documentation describing each inspection step, the result, and any corrective action required.
- i. If corrective action is required by Installer that cannot be completed during the same visit, provide additional visits, as required, until deficiencies are resolved and systems are deemed ready for startup.
- j. Final report shall indicate the system(s) inspected are installed according to manufacturer's requirements and are ready for startup.

B. Perform the following tests and inspections with the assistance of manufacturer's service representative:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

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 motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Refrigerant Tubing Positive Pressure Testing:

1. Comply with more stringent of VRF HVAC system manufacturer's requirements and requirements indicated.
2. After completion of tubing installation, pressurize tubing systems to a test pressure of not less than 1.2 times VRF HVAC system operating pressure, but not less than 600 psig, using dry nitrogen.
3. Successful testing shall maintain a test pressure for a continuous and uninterrupted period of 24 hours. Allowance for pressure changes attributed to changes in ambient temperature are acceptable.
4. Prepare test report to record the following information for each test:
 - a. Name of person starting test, company name, phone number, and e-mail address.
 - b. Name of manufacturer's service representative witnessing test, company name, phone number, and e-mail address.
 - c. Detailed description of extent of tubing tested.
 - d. Date and time at start of test.
 - e. Test pressure at start of test.
 - f. Outdoor temperature at start of test.
 - g. Name of person ending test, company name, phone number, and e-mail address.
 - h. Date and time at end of test.
 - i. Test pressure at end of test.

- j. Outdoor temperature at end of test.
 - k. Remarks:
5. Submit test reports for Project record.

D. Refrigerant Tubing Evacuation Testing:

- 1. Comply with more stringent of VRF HVAC system manufacturer's requirements and requirements indicated.
- 2. After completion of tubing positive-pressure testing, evacuate tubing systems to a pressure of 500 microns.
- 3. Successful testing shall maintain a test pressure for a continuous and uninterrupted period of one hour(s) with no change.
- 4. Prepare test report to record the following information for each test:
 - a. Name of person starting test, company name, phone number, and e-mail address.
 - b. Name of manufacturer's service representative witnessing test, company name, phone number, and e-mail address.
 - c. Detailed description of extent of tubing tested.
 - d. Date and time at start of test.
 - e. Test pressure at start of test.
 - f. Outdoor temperature at start of test.
 - g. Name of person ending test, company name, phone number, and e-mail address.
 - h. Date and time at end of test.
 - i. Test pressure at end of test.
 - j. Outdoor temperature at end of test.
 - k. Remarks:
- 5. Submit test reports for Project record.

6. Upon successful completion of evacuation testing, system shall be charged with refrigerant.

E. System Refrigerant Charge:

1. Using information collected from the refrigerant tubing evacuation testing, system Installer shall consult variable refrigerant system manufacturer to determine the correct system refrigerant charge.
2. Installer shall charge system following VRF HVAC system manufacturer's written instructions.
3. System refrigerant charging shall be witnessed by system manufacturer's representative.
4. Total refrigerant charge shall be recorded and permanently displayed at the system's outdoor unit.

F. Products will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

3.17 STARTUP SERVICE

A. Engage a VRF HVAC system manufacturer's service representative to perform system(s) startup service.

1. Service representative shall be a factory-trained and -authorized service representative of VRF HVAC system manufacturer.
2. Complete startup service of each separate system.
3. Complete system startup service according to manufacturer's written instructions.

B. Startup checks shall include, but not be limited to, the following:

1. Check control communications of equipment and each operating component in system(s).
2. Check each indoor unit's response to demand for cooling and heating.
3. Check each indoor unit's response to changes in airflow settings.
4. Check each indoor unit and outdoor unit for proper condensate removal.

5. Check sound levels of each indoor and outdoor unit.
- C. Installer shall accompany manufacturer's service representative during startup service and provide manufacturer's service representative with requested documentation and technical support during startup service.
 1. Installer shall correct deficiencies found during startup service for reverification.
- D. System Operation Report:
 1. After completion of startup service, manufacturer shall issue a report for each separate system.
 2. Report shall include complete documentation describing each startup check, the result, and any corrective action required.
 3. Manufacturer shall electronically record not less than [two] <Insert number> hours of continuous operation of each system and submit with report for historical reference.
 - a. All available system operating parameters shall be included in the information submitted.
- E. Witness:
 1. Invite Owner and Commissioning Agent to witness startup service procedures.
 2. Provide written notice not less than 20 business days before start of startup service.

3.18 ADJUSTING

- A. Adjust equipment and components to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust initial temperature and humidity set points. Adjust initial airflow settings and discharge airflow patterns.
- C. Set field-adjustable switches and circuit-breaker trip ranges according to VRF HVAC system manufacturer's written instructions, and as indicated.

3.19 PROTECTION

- A. Protect products from moisture and water damage. Remove and replace products that are wet, moisture damaged, or mold damaged.

- B. Protect equipment from physical damage. Replace equipment with physical damage that cannot be repaired to new condition. Observable surface imperfections shall be grounds for removal and replacement.
- C. Protect equipment from electrical damage. Replace equipment suffering electrical damage.
- D. Cover and seal openings of equipment to keep inside of equipment clean. Do not remove covers until finish work is complete.

3.20 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by manufacturer's authorized service representative. Include two service visits for preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper equipment and system operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.21 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.
- B. 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 and access the system and to upgrade computer equipment if necessary.

3.22 DEMONSTRATION

- A. Engage a VRF HVAC system manufacturer's factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain entire system.
- B. Instructor:
 - 1. Instructor shall be factory trained and certified by VRF HVAC system manufacturer with current training on the system(s), equipment, and controls that are installed.

2. Instructor's credentials shall be submitted for review by Architect before scheduling training.
3. Instructor(s) primary job responsibility shall be Owner training.
4. Instructor(s) shall have not less than three years of training experience with VRF HVAC system manufacturer and past training experience on at least three projects of comparable size and complexity.

C. Schedule and Duration:

1. Schedule training with Owner at least 20 business days before first training session.
2. Training shall occur before Owner occupancy.
3. Training shall be held at mutually agreed date and time during normal business hours.
4. Each training day shall not exceed eight hours of training. Daily training schedule shall allow time for one-hour lunch period and 15-minute break after every two hours of training.
5. Perform not less than eight total hours of training.

D. Location: Owner shall provide a suitable on-site location to host classroom training.

E. Training Attendees: Assume three people.

F. Training Attendance: For record purposes, document training attendees at the start of each new training session. Record attendee's name, signature, phone number, and e-mail address.

G. Training Format: Individual training modules shall include classroom training followed by hands-on field demonstration and training.

H. Training Materials: Provide training materials in electronic format to each attendee.

1. Include instructional videos showing general operation and maintenance that are coordinated with operation and maintenance manuals.
2. Video record each classroom training session and submit an electronic copy to Owner before requesting Owner acceptance of training.

- I. Acceptance: Obtain Owner written acceptance that training is complete and requirements indicated have been satisfied.

END OF SECTION 23 81 29

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SECTION 23 82 39.16 - PROPELLER UNIT HEATERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes propeller unit heaters with electric-resistance heating coils.

1.2 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 location and size of each field connection.
 - 4. Include details of anchorages and attachments to structure and to supported equipment.
 - 5. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
 - 6. Indicate location and arrangement of integral controls.
 - 7. Wiring Diagrams: Power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Suspended ceiling components.
 - 2. Structural members to which propeller unit heaters will be attached.

3. Method of attaching hangers to building structure.
4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.

B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For propeller 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. Airtherm; a Mestek company.
2. CCI Thermal Technologies, Inc.
3. Engineered Air.
4. Trane.

2.2 DESCRIPTION

A. Assembly including casing, coil, fan, and motor in vertical and horizontal discharge configuration with adjustable discharge louvers.

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 UL 2021.

2.3 PERFORMANCE REQUIREMENTS

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

2.4 HOUSINGS

A. Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heaters before shipping.

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.

2.5 COILS

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 steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch. Element ends shall be enclosed in terminal box. Fin surface temperature shall not exceed 550 deg F at any point during normal operation.

1. Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters.

2. Wiring Terminations: Stainless-steel or corrosion-resistant material.

2.6 FAN AND MOTOR

A. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.

B. Motor: Permanently lubricated, multispeed. Comply with requirements in Section 230500 "Common Work Results for HVAC."

2.7 CONTROLS

A. Control Devices:

1. Wall-mounted thermostat, line voltage.

2.8 CAPACITIES AND CHARACTERISTICS

A. As scheduled on the drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive propeller 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 propeller unit heaters to comply with NFPA 90A.
- B. Install propeller unit heaters level and plumb.
- C. Suspend propeller unit heaters from structure with all-thread hanger rods and spring hangers. Hanger rods and attachments to structure are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers are specified in Section 230548 "Vibration Controls for HVAC."
- D. 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.

3.3 CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
 - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- B. Units will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust initial temperature set points.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain propeller unit heaters.

END OF SECTION 23 82 39.16

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SECTION 26 00 50 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.
2. Common electrical installation requirements.

1.2 DESCRIPTION OF WORK

A. Requirements of this Section are applicable to work in Divisions 26 and 28.

B. Contract Documents

1. Contract drawings for electrical work are diagrammatic, intended to convey scope and general arrangement.
2. Refer questions involving document interpretation or discrepancies to Engineer for review and direction.
3. Correct faulty work due to resolving discrepancies without proper approval.
4. Specifications establish quality of materials, equipment, workmanship and methods of construction.
5. Follow drawings and specifications in laying out work. Consult other applicable contract drawings and specifications, become familiar with conditions affecting work.

C. Scope

1. Furnish and install the electrical work complete and ready for satisfactory service.

D. Definitions: The following are definitions of terms and expressions used in Divisions 26, 27 and 28.

1. “Accessible” – Capable of being removed or exposed without damaging the building or structure or finish or not permanently closed in by other equipment or by the structure or finish of the building.
2. “Approve” - To permit use of material, equipment or methods conditional upon compliance with contract document requirements.

3. “Concealed” - Hidden from normal sight; includes work in crawl spaces, above ceilings, and in building shafts.
4. “Directed” - directed by Engineer.
5. “Equal, equivalent” - possessing the same performance qualities and characteristics and fulfilling the same utilitarian function.
6. “Exposed” - not concealed.
7. “Furnish” - Supply and deliver to project site, ready for unloading, unpacking, assembly, installation, and similar operations.
8. “Indicated” - indicated in Contract Documents.
9. “Install” - Operations at project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimensions, finishing, curing, protecting, cleaning and similar operations.
10. “Provide” - furnish and install, complete and ready for the intended use.
11. “Removable” - detachable from the structure or system without physical alteration of materials or equipment and without disturbance to other construction.
12. “Review” - limited observation or checking to ascertain general conformance with design concept of the work and with information given in contract documents. Such action does not constitute a waiver or alteration of the contract requirements.

1.3 QUALITY ASSURANCE

- A. Regulations: Comply with regulations of NFPA, state, county, and municipal building ordinances, and other applicable codes and regulations.
- B. Provide UL label on electric powered equipment or certification that equipment has been tested by a testing agency approved by the local authority as equivalent in safety to UL labeled equipment.
- C. Material and Equipment Requirements
 1. All materials and equipment shall be new and free from defects.
 2. Use products of one manufacturer where two or more items of same kind of equipment are required.
 3. For certain items of equipment, the specification and the project design are based upon the specified manufacturer's product. Other manufacturers' names are listed.

Contractor may purchase, conditional upon meeting project requirements, equipment from the listed manufacturers.

4. Only the manufacturer's equipment upon which the specification and the project design has been based, has been checked for this project. Check allocated space and structure for suitability of equipment of other listed manufacturers, including parts replacement and servicing.

D. Workmanship

1. Remove and replace, at no extra cost, work not in conformance with contract requirements.
2. Coordinate with Other Trades
 - a. Coordinate work and cooperate with other trades to facilitate execution of work.
 - b. Give full cooperation and coordination with other trades and furnish information necessary to permit the work of all trades to be installed satisfactorily with the least possible interference or delay.
 - c. Furnish to other trades, as required, necessary templates, patterns, setting plans and shop details for the proper installation of the work and for the purpose of coordinating adjacent work.
3. Accessible Equipment and Systems:
 - a. Consider all materials and equipment installations and coordinate with the work of other trades to ensure equipment or systems are accessible for operations, maintenance, repairs, and replacement.
 - b. Install materials and equipment, including but not limited to, supports and electrical conduit, to permit complete unobstructed access to panelboards, transformers, and other items requiring access for inspection, maintenance, and operations.
 - c. Engineer will disapprove the installation of new equipment or materials which renders new or existing equipment inaccessible, and Contractor shall correct the Work.

1.4 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment as follows:

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 that 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. Locate electrical items requiring access in spaces with accessible ceilings. Where electrical items requiring access cannot be located in spaces with accessible ceilings, coordinate location with Architect and provide panels and doors for access to items that are behind finished surfaces or otherwise concealed.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Penetration Firestopping."
- E. Coordinate power requirements with mechanical controls. Provide 1P-20A circuit breaker in nearest normal power panel for mechanical controls and dampers requiring 120V power. Provide wiring and conduit as required.

1.5 SHOP DRAWINGS AND SUBMITTALS

- A. Refer to Division 01 for complete requirements.
- B. Submit all products for a single specification section as a complete submittal. All products specified within a division shall be included, otherwise submittal will be returned as incomplete.
- C. Clearly mark submittals to indicate actual intended products to be utilized. Marks may include highlighting, circling, boxing, checking, etc. Do not provide submittal data which lists multiple product's options and features without clearly indicating which data applies to the products intended to be used on project.
- D. Coordinate drawings and data before submitting and certify that provisions of the contract documents have been met.
- E. Call attention, in writing, to deviations from contract requirements.

- F. Do not fabricate, deliver to site, or install items requiring shop drawing review, until the review has been completed by the Engineer and the shop drawing has been marked to indicate "No Exception Taken" or "Make Corrections Noted."
- G. Use only final or corrected drawings and data for construction. This includes all Addendums, Architectural Supplemental Information (ASIs), and Change Bulletins.
- H. The Engineer's review of submittals shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory. Approval will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the requirements of this contract is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work.

PART 2 PRODUCTS (NOT USED)

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-mounted 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.
- F. Provide comprehensive on-site factory training on electrical equipment operation and safety concerns for personnel who will operate the building.

3.2 FIRESTOPPING

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 7 Section "Penetration Firestopping."

END OF SECTION 26 05 00

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper building wire.
2. Metal-clad cable, Type MC.
3. Connectors and splices.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Copper building wire.
2. Metal-clad cable, Type MC.
3. Connectors and splices.

B. Product Schedule: Indicate type, use, location, and termination locations.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 PRODUCTS

2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. 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. General Cable Technologies Corporation.
 2. Service Wire Co.

3. Southwire Company.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

- D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

E. Conductor Insulation:

1. Type THHN and Type THWN-2. Comply with UL 83.

2.2 METAL-CLAD CABLE, TYPE MC

- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

- B. 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. Alpha Wire Company.
2. American Bare Conductor.
3. General Cable Technologies Corporation.
4. Okonite Company (The).
5. Service Wire Co.
6. Southwire Company.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1569.

3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Circuits:

1. Single circuit.
2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.

- E. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

- F. Ground Conductor: Insulated.

G. Conductor Insulation:

1. Type TFN/THHN/THWN-2. Comply with UL 83.

- H. Armor: Steel or Aluminum, interlocked.

- I. Jacket: PVC applied over armor.

2.3 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

- B. 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. 3M Electrical Products.
2. AFC Cable Systems; a part of Atkore International.
3. Gardner Bender.
4. Hubbell Power Systems, Inc.
5. Ideal Industries, Inc.
6. ILSCO.
7. O-Z/Gedney; a brand of Emerson Industrial Automation.

8. Service Wire Co.
9. Thomas & Betts Corporation; A Member of the ABB Group.

PART 3 EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders:
 1. Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits:
 1. 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-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- E. Feeders Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway.
- F. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway, Metal-clad cable, Type MC.
- G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
- H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- I. Branch Circuits Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway, Metal-clad cable, Type MC.
- 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.

3.3 INSTALLATION, GENERAL

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points in accordance with Section 26 05 33 " Raceways and Boxes for Electrical Systems " prior to pulling conductors and cables.
- C. 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.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 26 05 29 "Hangers and Supports 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-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 26 05 53 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

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 Section 07 84 13 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
2. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements:
3. Perform each of the following visual and electrical tests:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - b. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - 3) Thermographic survey.
 - c. Inspect compression-applied connectors for correct cable match and indentation.
 - d. Inspect for correct identification.
 - e. Inspect cable jacket and condition.
 - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500 V(dc) for 300 V rated cable and 1000 V(dc) for 600 V rated cable for a one-minute duration.
 - g. Continuity test on each conductor and cable.
 - h. Uniform resistance of parallel conductors.

- B. Cables will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports to record the following:
 - 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 26 05 19

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SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes grounding and bonding systems and equipment, plus the following special applications:
 - 1. Underground distribution grounding.
 - 2. Ground bonding common with lightning protection system.
 - 3. Foundation steel electrodes. (Ufer ground)
 - 4. Intersystem bonding termination devices for the connection of communications systems bonding conductors.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans showing dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
 - 1. Ground rods.
 - 2. Grounding arrangements and connections for separately derived systems.
- B. Qualification Data: For testing agency and testing agency's field supervisor.
- C. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
 - a. Plans showing as-built, dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:

- 1) Ground rods.
- 2) Grounding arrangements and connections for separately derived systems.
- b. Instructions for periodic testing and inspection of grounding features at test wells and grounding connections for separately derived systems] based on NFPA 70B:
 - 1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
 - 2) Include recommended testing intervals.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Certified by NETA.

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. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Burndy; Part of Hubbell Electrical Systems.
 2. ERICO International Corporation.
 3. Harger Lightning & Grounding.
 4. Thomas & Betts Corporation; A Member of the ABB Group.

2.3 CONDUCTORS

- A. 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 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 wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

B. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression or exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- D. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.
- E. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- F. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- G. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.
- H. Conduit Hubs: Mechanical type, terminal with threaded hub.

- I. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- J. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
- K. Straps: Solid copper, copper lugs. Rated for 600 A.
- L. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- M. Water Pipe Clamps:
 - 1. Mechanical type, two pieces with stainless-steel bolts.
 - a. Material: Tin-plated aluminum.
 - b. Listed for direct burial.
 - 2. U-bolt type with malleable-iron clamp and copper ground connector.

2.5 INTERSYSTEM BONDING TERMINATION DEVICE

- A. Lay-in connection clamp accepts 6 AWG through 2 AWG grounding electrode conductor.
- B. Accommodates minimum of five 14 AWG through 4 AWG bonding conductors.
- C. Housing and integral mounting base:
 - 1. 4-inch wide by 2-inch high by 1 1/2-inch deep.
 - 2. Polymeric, impact resistant, and UV-stabilized.
 - 3. Corrosion resistant, stainless steel mounting hardware.

2.6 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch diameter by 10 feet.
- B. Ground Plates: 1/4 inch thick, hot-dip galvanized.

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 tinned-copper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least 24 inches below grade.
 - 2. Duct-Bank Grounding Conductor: Bury 12 inches 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 equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches 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, and down; 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 AND BONDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 EQUIPMENT GROUNDING AND BONDING

- 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.
- 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. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.
 - 1. 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, or wiring closet.
 - 2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch grounding bus.
 - 3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

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. Ground Rods: Drive rods until tops are 2 inches 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. Use exothermic welds for all below-grade connections.
 - 3. 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.
- C. Intersystem Bonding Termination Devices:
 - 1. Install in close proximity to electrical and communications service entrances and in locations accessible for inspection and maintenance.
 - 2. Connect to equipment enclosure or grounding electrode conductor in accordance with NEC requirements.
- D. 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 bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- E. 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; use a bolted clamp connector or bolt a lug-type connector to a

- pipe flange by 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.
- F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.
- G. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.
1. If concrete foundation is less than 20 feet 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's grounding grid or to grounding electrode external to concrete.
- H. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 2. Make connections with clean, bare metal at points of contact.
 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.5 LABELING

- A. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems" for instruction signs. The label or its text shall be green.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: 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. Tests and Inspections:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 - 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer 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.
 - 4. 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.
- E. Grounding system will be considered defective if it does not pass tests and inspections.

- F. Prepare test and inspection reports.
- G. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
 - 2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
 - 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 - 4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohms.
- H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hangers and supports for electrical equipment and systems.

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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Allied Tube & Conduit; a part of Atkore International.
 - b. B-line, an Eaton business.
 - c. ERICO International Corporation.
 - d. Flex-Strut Inc.
 - e. Thomas & Betts Corporation; A Member of the ABB Group.
 - f. Unistrut; Part of Atkore International.
2. Material: Galvanized steel.
3. Channel Width: 1-5/8 inches.
4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
5. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
6. Channel Dimensions: Selected for applicable load criteria.

- B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored 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 made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.
- E. 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.
 - 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 where used.
 - 3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
 - 4. Hanger Rods: Threaded steel.

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 unless requirements in this Section are stricter.
- B. Comply with requirements for raceways and boxes specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."
- C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as scheduled in NECA 1, where its Table 1 lists maximum spacing that are less than those stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

- D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other 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.
- E. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits 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, EMTs may be supported by openings through structure members, according to 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.
- 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 Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 3. To Existing Concrete: Expansion anchor fasteners.
 - 4. 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 the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation to support electrical materials and equipment.
- B. Finish exposed surfaces smooth and blended so no roughness shows.
- C. Set metal fabrications with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- D. Field Welding: Comply with AWS D1.1/D1.1M.
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- E. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

3.4 PAINTING

- A. Touchup: Comply with requirements in Section 09 91 00 "Painting and Finishing" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 05 29

SECTION 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Surface raceways.
5. Boxes, enclosures, and cabinets.

B. Related Requirements:

1. Section 26 05 43 "Underground Ducts and Raceways for Electrical Systems" for exterior duct banks and underground utility construction.
2. Section 27 05 28 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

1.2 DEFINITIONS

- A. GRC:** Galvanized rigid steel conduit.
- B. IMC:** Intermediate metal conduit.

1.3 ACTION SUBMITTALS

- A. Product Data:** For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings:** For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

PART 2 PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- 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. Allied Tube & Conduit; a part of Atkore International.
 2. Anamet Electrical, Inc.
 3. Calconduit.
 4. O-Z/Gedney; a brand of Emerson Industrial Automation.
 5. Picoma Industries, Inc.
 6. Republic Conduit.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. IMC: Comply with ANSI C80.6 and UL 1242.
- E. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
1. Comply with NEMA RN 1.
 2. Coating Thickness: 0.040 inch, minimum.
- F. EMT: Comply with ANSI C80.3 and UL 797.
- G. FMC: Comply with UL 1; zinc-coated steel or aluminum.
- H. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- I. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
1. Fittings for EMT:
 - a. Material: Steel or die cast.

- b. Type: Setscrew or compression.
- 2. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
- 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- J. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

- 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. AFC Cable Systems; a part of Atkore International.
 - 2. Anamet Electrical, Inc.
 - 3. Arnco Corporation.
 - 4. CANTEX INC.
 - 5. CertainTeed Corporation.
 - 6. Condux International, Inc.
 - 7. Electri-Flex Company.
 - 8. Lamson & Sessions.
 - 9. Thomas & Betts Corporation; A Member of the ABB Group.
- B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. ENT: Comply with NEMA TC 13 and UL 1653.
- D. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

- E. LFNC: Comply with UL 1660.
- F. Rigid HDPE: Comply with UL 651A.
- G. Continuous HDPE: Comply with UL 651B.
- H. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.
- I. RTRC: Comply with UL 1684A and NEMA TC 14.
- J. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- K. Fittings for LFNC: Comply with UL 514B.
- L. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- 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. B-line, an Eaton business.
 - 2. Hoffman; a brand of Pentair Equipment Protection.
 - 3. MonoSystems, Inc.
 - 4. Square D.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 or Type 3R unless otherwise indicated, and sized according to NFPA 70.
 - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, 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 unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.4 BOXES, ENCLOSURES, AND CABINETS

- 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. Adalet.
 - 2. Erickson Electrical Equipment Company.
 - 3. Hoffman; a brand of Pentair Equipment Protection.
 - 4. Milbank Manufacturing Co.
 - 5. O-Z/Gedney; a brand of Emerson Industrial Automation.
 - 6. RACO; Hubbell.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- H. Device Box Dimensions: 4 inches square by 2-1/8 inches deep 4 inches by 2-1/8 inches by 2-1/8 inches deep (100 mm by 60 mm by 60 mm deep).
- I. Gangable boxes are prohibited.
- J. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 or Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

PART 3 EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: PVC-coated rigid steel conduit.
2. Concealed Conduit, Aboveground: RNC, Type EPC-40-PVC.
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. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
5. Damp or Wet Locations: GRC or IMC.
6. 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 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. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting

manufacturer and apply in thickness and number of coats recommended by manufacturer.

3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches 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. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches of enclosures to which attached.
- I. Raceways Embedded in Slabs:
 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.

3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Owner for each specific location.
5. Change from ENT to GRC or IMC before rising above floor.
- J. 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.
- K. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- L. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- N. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- O. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- P. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- Q. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- R. Install raceway sealing fittings at accessible locations according to NFPA 70 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 according to NFPA 70.

- S. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
 - 1. Where an underground service raceway enters a building or structure.
 - 2. Where otherwise required by NFPA 70.
- T. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- U. Expansion-Joint Fittings:
 - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
 - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Attics: 135 deg F temperature change.
 - 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
 - 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 - 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

- V. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for 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.
- W. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- X. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- Y. Locate boxes so that cover or plate will not span different building finishes.
- Z. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- AA. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.4 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33

SECTION 26 05 43 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Conduit, ducts, and duct accessories for direct-buried duct banks, and in single duct runs.
2. Polymer Concrete In-Ground Pull Boxes.

B. Related Requirements: Section 26 05 53 "Identification for Electrical Systems" for warning tape for underground ducts and raceways.

1.2 DEFINITION

A. RNC: Rigid nonmetallic conduit.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Duct-bank materials, including separators and miscellaneous components.
2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
3. Handholes, boxes, and accessories.

B. Shop Drawings for Factory-Fabricated Polymer Concrete Boxes: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:

1. Duct entry provisions, including locations and duct sizes.
2. Cover design.

1.4 QUALITY ASSURANCE

A. Comply with ANSI C2.

B. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.
- B. Store factory-fabricated underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

1.6 COORDINATION

- A. Coordinate layout and installation of ducts and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.
- B. Coordinate elevations of duct entrances into boxes with final locations and profiles of ducts as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to handholes, and as approved by Owner.

PART 2 PRODUCTS

2.1 CONDUIT

- A. Coated Steel Conduit: PVC-Coated rigid steel conduit.
 - 1. Comply with NEMA RN 1.
 - 2. Coating Thickness: 0.040 inch, minimum.
- B. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.
- C. RNC: NEMA TC 2, Type EPC-40-PVC and Type EPC-80-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.2 NONMETALLIC DUCTS AND DUCT ACCESSORIES

- 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. ARNCO Corp.
 - 2. Beck Manufacturing.

3. Cantex, Inc.
4. CertainTeed Corp.; Pipe & Plastics Group.
5. Condux International, Inc.
6. ElecSys, Inc.
7. Electri-Flex Company.
8. IPEX Inc.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT; a division of Cable Design Technologies.
11. Spiraduct/AFC Cable Systems, Inc.

B. Duct Accessories:

1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.

2.3 POLYMER CONCRETE IN-GROUND PULL BOXES

A. Description: Comply with SCTE 77.

1. Color: Gray, tan, or green as indicated on drawings.
2. Configuration: Units shall be designed for flush burial and have open 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", "FIRE ALARM", "COMMUNICATIONS", or "CONTROL" as indicated.
6. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.

- B. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.
 - 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:
 - a. Strongwell
 - b. Quazite of Hubbell Power Systems
 - c. Armorcast Products Company.
 - d. Carson Industries LLC.
 - e. CDR Systems Corporation, Electrimold.

2.4 SOURCE QUALITY CONTROL

- A. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 - 1. Strength tests of complete boxes and covers shall be by either an independent testing agency or the manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 - 2. 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 UNDERGROUND DUCT APPLICATION

- A. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.
- B. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.
- C. Underground Ducts Crossing Paved Paths, Walks and Driveways: RNC, NEMA Type EPC-40-PVC, encased in reinforced concrete.

3.2 UNDERGROUND ENCLOSURE APPLICATION

A. Handholes and Boxes for 600 V and Less:

1. Units in Driveway, Parking Lot, Off-Roadway Locations, Sidewalks, and all other locations Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.

3.3 EARTHWORK

- #### A. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed topsoil and sod immediately after backfilling is completed.

- #### B. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work.

3.4 DUCT INSTALLATION

- #### A. Slope: Pitch ducts a minimum slope of 1:300 down toward handholes and away from equipment. Slope ducts from a high point in runs between two handholes to drain in both directions.
- #### B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, both horizontally and vertically, at other locations, unless otherwise indicated.
- #### C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.
- #### D. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.
- #### E. Pulling Cord: Install 100-lbf-test nylon cord in ducts, including spares.
- #### F. Direct-Buried Duct Banks:
1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
 2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due

to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches between tiers.

3. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Section 31 00 00 "Earthwork" for pipes less than 6 inches in nominal diameter.
 4. Install backfill as specified in Section 31 00 00 "Earthwork."
 5. Depth: Install top of duct bank at least 24 inches below finished grade, unless otherwise indicated.
 6. Set elevation of bottom of duct bank below the frost line.
 7. Install manufactured PVC Coated rigid steel conduit elbows for stub-ups at poles and equipment.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
- G. Underground-Line Warning Tape: Bury underground-line warning tape no less than 12 inches above all duct banks and approximately 12 inches below grade. Align tape parallel to and within 3 inches of centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

3.5 INSTALLATION OF POLYMER CONCRETE BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas and trafficways, set so cover surface will be flush with finished grade. Set covers of other handholes 1 inch above finished grade.
- D. Install handholes and boxes with bottom below the frost line.
- 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 ducts and 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.
- G. For enclosures installed in asphalt paving and subject to occasional, non-deliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.
 - 1. Concrete: 3000 psi, 28-day strength with a troweled finish.
 - 2. Dimensions: 10 inches wide by 12 inches deep.

3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
 - 1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
 - 2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
- B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.7 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 26 05 43

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SECTION 26 05 44 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.
6. Duct sealing system

B. Related Requirements:

1. Section 07 84 13 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.2 ACTION SUBMITTALS

- ##### **A. Product Data:** For each type of product.

PART 2 PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. 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 Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:**
- Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE-SEAL SYSTEMS

- 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. Metraflex Company (The).
 - c. Pipeline Seal and Insulator, Inc.
 2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 3. Pressure Plates: Stainless steel.
 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
 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. HOLDRITE.

2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

2.6 DUCT SEALING SYSTEM

- A. Foam Sealants: Two-part closed cell urethane foam. It shall react and set in 5-10 minutes at 70 degrees Fahrenheit. It shall be capable of sealing ¾" to 10" conduits with multiple cable configurations. Duct sealant shall be reenterable. Duct sealant shall not affect the physical or electrical properties of wire and cable. It shall have 120 pound compressive strength. It shall be listed to meet NEC for raceway seals, meet the UL 94 fire rating HFB, and be UL listed.
 - 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. American Polywater Corporation FST Foam Sealant

PART 3 EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.

- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 07 92 00 "Joint Sealants."
 - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
 - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
 - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals. Coordinate penetration details with air barrier manufacturer's requirements.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install 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.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 26 05 44

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SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Color and legend requirements for raceways, conductors, and warning labels and signs.
- 2. Labels.
- 3. Bands and tubes.
- 4. Tapes and stencils.
- 5. Tags.
- 6. Signs.
- 7. Cable ties.
- 8. Paint for identification.
- 9. Fasteners for labels and signs.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1.

- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Comply with NFPA 70E and Section 26 05 73.19 "Arc-Flash Hazard Analysis" requirements for arc-flash warning labels.
- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.
- B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 - 1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
 - 2. Colors for 240/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - 3. Color for Neutral: White.
 - 4. Color for Equipment Grounds: Green.
- C. Warning Label Colors:
 - 1. Identify system voltage with black letters on an orange background.
- D. Warning labels and signs 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."

E. Equipment Identification Labels:

1. Black letters on a white field.

2.3 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
- B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameter and that stay in place by gripping action.
- C. Self-Adhesive Wraparound Labels: , 3-mil-thick, polyester or vinyl flexible label with acrylic pressure-sensitive adhesive.
 1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
 2. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.
- D. Self-Adhesive Labels: Polyester or Vinyl, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
 1. Minimum Nominal Size:
 - a. 1-1/2 by 6 inches for raceway and conductors.
 - b. 3-1/2 by 5 inches for equipment.
 - c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

- A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameter and that stay in place by gripping action.

2.5 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.
- C. Tape and Stencil: 4-inch-wide black stripes on 10-inch centers placed diagonally over orange background and is 12 inches wide. Stop stripes at legends.
- D. Floor Marking Tape: 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.
- E. Underground-Line Warning Tape:
 - 1. Tape:
 - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
 - 2. Color and Printing:
 - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
 - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
 - c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".

2.6 TAGS

- A. Write-on Tags:
 - 1. Polyester Tags: 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment.

2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.7 SIGNS

A. Baked-Enamel Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal Size: 7 by 10 inches.

B. Metal-Backed Butyrate Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal Size: 10 by 14 inches.

C. Laminated Acrylic or Melamine Plastic Signs:

1. Engraved legend.
2. Thickness:
 - a. For signs up to 20 sq. in., minimum 1/16 inch thick.
 - b. For signs larger than 20 sq. in., 1/8 inch thick.
 - c. Engraved legend with black letters on white face for instructional signs and white letters on a dark gray background for identification signs.
 - d. Punched or drilled for mechanical fasteners with 1/4-inch grommets in corners for mounting.
 - e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 Deg F according to ASTM D638: 12,000 psi.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black, except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 Deg F according to ASTM D638: 12,000 psi.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black.
- C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 Deg F according to ASTM D638: 7000 psi.
 - 3. UL 94 Flame Rating: 94V-0.
 - 4. Temperature Range: Minus 50 to plus 284 deg F.
 - 5. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. 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 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.
- H. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
 - 1. Secure tight to surface of conductor, cable, or raceway.
- I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- J. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.
- K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- L. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. "EMERGENCY POWER."

2. "POWER."
3. "FIRE ALARM."

M. Vinyl Wraparound Labels:

1. Secure tight to surface at a location with high visibility and accessibility.
2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

N. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.

O. Self-Adhesive Wraparound Labels: Secure tight to surface of raceway or cable at a location with high visibility and accessibility.

P. Self-Adhesive Labels:

1. On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.

Q. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

R. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.

S. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

T. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

U. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

V. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.

W. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.
2. Install underground-line warning tape for direct-buried cables and cables in raceways.

X. Write-on Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using UV-stabilized cable ties.

Y. Metal-Backed Butyrate Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.

Z. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.2 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:
 1. "EMERGENCY POWER."

2. "POWER."
 3. "FIRE ALARM."
- D. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use vinyl wraparound labels, self-adhesive wraparound labels, snap-around labels, snap-around color-coding bands, or self-adhesive vinyl tape to identify the phase.
1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- E. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive wraparound labels with the conductor or cable designation, origin, and destination.
- F. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive wraparound labels with the conductor designation.
- G. Auxiliary Electrical Systems Conductor Identification: Marker tape or Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.
1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
- H. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- I. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- J. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- K. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs or Metal-backed, butyrate warning signs.
1. Apply to exterior of door, cover, or other access.
 2. For 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.
- L. Arc Flash Warning Labeling: Self-adhesive labels.
- M. Operating Instruction Signs: Baked-enamel warning signs, Metal-backed, butyrate warning signs, or Laminated acrylic or melamine plastic signs.
- N. Emergency Operating Instruction Signs: Baked-enamel warning signs, Metal-backed, butyrate warning signs, or Laminated acrylic or melamine plastic signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.
- O. Equipment Identification Labels:
- 1. Indoor Equipment: Baked-enamel signs, Metal-backed butyrate signs, or Laminated acrylic or melamine plastic sign.
 - 2. Outdoor Equipment: Laminated acrylic or melamine sign.

END OF SECTION 26 05 53

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SECTION 26 09 23 – LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Lighting control panels using mechanically held relays for switching and dimming.
2. Indoor occupancy and vacancy sensors.
3. Switchbox-mounted occupancy and vacancy sensors
4. Outdoor mounted photocells.

B. Related Requirements:

1. Section 26 27 26 "Wiring Devices" for wall plates.
- C.** Coordinate, receive, mount, connect, and place into operation all equipment to make a complete and operable code-compliant lighting control system. Furnish all conduit, wire connectors, hardware, and other incidental items necessary for the complete and properly functioning lighting control system as described herein and shown on the plans.
- D.** Provide all components required to interface with AV system and shade control systems in locations indicated on the drawings.

1.2 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 control modules, power distribution components, relays, manual switches and plates, and conductors and cables.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Operational documentation for software and firmware.

B. Shop Drawings:

1. Show installation details for the following:

- a. Lighting control panels.
 - b. Occupancy sensors.
2. Interconnection diagrams showing field-installed wiring.
3. Include diagrams for power, signal, and control wiring.
4. Detail wiring partition configuration, current, and voltage ratings.
5. Short circuit current rating of lighting control panel relays.
6. Lighting control schedules and wire termination diagrams. Coordinate nomenclature and presentation with drawings and diagrams. Differentiate between manufacturer installed and field installed wiring.

C. Example Contractor Startup/Commissioning Worksheet.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and elevations, drawn to scale and coordinated with each other, using input from installers of the items involved.
- B. Software licenses and upgrades required by and installed for operation and programming of digital and analog devices.
- C. Field quality-control reports.
- D. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
- B. Software and firmware operational documentation.
- C. Program software backup: on USB drive with username and password for manufacturers support website.

1.5 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

1.6 ADJUSTMENT

- A. Occupancy Adjustments: When requested within 5 years from date of Substantial Completion, provide a manufacturer certified technician for on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to six visits to Project during other-than-normal occupancy hours for this purpose.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Lighting control system consists of three types of control.
 1. Stand alone switch box mounted occupancy and vacancy sensors.
 2. Distributed relay system.
 3. Centralized relay and dimming systems.
- 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.

2.2 LIGHTING CONTROL PANELS

- A. Manufacturers: Basis of Design is Acuity Brands panel with Unity GX2 software. Subject to compliance with requirements, provide products by one of the following:
 1. Lithonia Lighting; Acuity Brands Lighting, Inc.
 2. Hubbell Building Automation, Inc.
 3. Leviton Manufacturing Co., Inc.
 4. Lutron Electronics Co., Inc.
 5. Sensor Switch, Inc.
 6. WattStopper; a Legrand® Group brand.
- B. Description: Lighting control panels using mechanically latched relays with 0-10V dimming capability to control lighting. Multiple panels shall be capable of being interconnected with digital communications to appear to the operator as a single lighting control system. Panels shall be controlled from touch panels with custom graphics, low

voltage switches, and through a lighting control software that has coordinate floorplan graphics.

- C. Sequence of Operations: Input signal from digital switches or timeclock shall open or close one or more lighting control relays in the lighting control panels. Relays utilizing switching and 0-10V dimming shall be provided as indicated in the Lighting Control Panel schedules shown on the drawings. Any combination of inputs shall be programmable to any number of control relays. Surge Protective Device: Factory installed as an integral part of control components or field mounted surge suppressors complying with UL 1449, SPD Type 2.
- D. Comply with UL 924 where both normal and emergency power sources are routed through lighting control panel
- E. Comply with UL 916.
- F. Panels shall have a barrier separating branch circuits from control wiring.
- G. Panels shall have a barrier separating normal and emergency power sources.
- H. Timing Unit:
 - 1. 365-day calendar, astronomical clock, and automatic adjustments for daylight savings and leap year.
 - 2. Clock configurable for 12-hour (AM/PM) or 24-hour format.
 - 3. Day of week, day of month, day of year with one-time or repeating capability.
- I. Nonvolatile memory shall retain all setup configurations. After a power failure, the controller shall automatically reboot and return to normal system operation.
- J. Relays: Electrically operated, mechanically held single-pole switch, rated at 20A at 120V. Short circuit current rating shall be not less than 15kA at 120V. Control shall be digital control network. Provide relays offering:
 - 1. Switching
 - 2. 0-10V Dimming
 - 3. Additional control types as required by lighting control schedule.
- K. Lighting Control Software: centralized and remote access for controlling, monitoring, and accessing analytics for lighting control systems. Lighting control system shall include:

1. Floorplan based interface with custom floorplans matched to this project.
2. Allow rezoning and scheduling.
3. Web enabled control to be used with standard web browser to access a locally hosted server from any PC or tablet.
4. Monitor and control all relays, showing actual relay state and the name of the actuating control.

2.3 INDOOR OCCUPANCY AND VACANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Building Automation, Inc.
2. Leviton Manufacturing Co., Inc.
3. Lithonia Lighting; Acuity Brands Lighting, Inc.
4. Lutron Electronics Co., Inc.
5. Sensor Switch, Inc.
6. WattStopper; a Legrand® Group brand.

B. General Requirements for Sensors:

1. Wall and Ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
2. Dual technology.
3. Integrated or Separate power pack.
4. Hardwired connection to switch and lighting control system, where indicated.
5. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
6. Operation:
 - a. Combination Sensor: Unless otherwise indicated, sensor shall be programmed to turn lights on to a reduced level when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have

been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

7. Sensor Output: Sensor is powered from the power pack.
 8. Power Pack: Dry contacts rated for 20-A LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
 9. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 10. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
 11. Bypass Switch: Override the "on" function in case of sensor failure.
 12. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.
- C. Dual-Technology Type: Wall and Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is 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-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
 4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 square feet 2000

square feet or 3000 square feet as required for installation location when mounted 48 inches above finished floor.

2.4 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hubbell Building Automation, Inc.
 - 2. Leviton Manufacturing Co., Inc.
 - 3. Lithonia Lighting; Acuity Brands Lighting, Inc.
 - 4. Lutron Electronics Co., Inc.
 - 5. Sensor Switch, Inc.
 - 6. WattStopper; a Legrand® Group brand.
- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on to a reduced level when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 - 3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
 - 4. Switch Rating: Not less than 800-VA LED load at 120 V, 1200-VA LED load at 277 V.
- C. Wall-Switch Sensor:
 - 1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft. 2100 sq. ft.
 - 2. Sensing Technology: Dual technology - PIR and ultrasonic.
 - 3. Switch Type: SP, field-selectable automatic "on," or manual "on," automatic "off."

4. Capable of controlling load in three-way application.
5. Voltage: Match the circuit voltage.
6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
7. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
8. Color: White.
9. Faceplate: Color as selected by Architect.
10. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.

D. Wall-Switch Sensor with Dimming:

1. Same as Wall-Switch Sensor except with Dimming Capability: 0-10V Control.

2.5 OUTDOOR MOUNTED PHOTOSENSORS

A. Description: Solid state, with dry contacts rated to operated connected microprocessor input; compatible with ballasts and LED lamps.

1. Listed and labeled as defined in NFPA 70 and marked for intended location and application.
2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range.
3. Time Delay: Fifteen-second minimum to prevent false operation.
4. Surge Protection: Metal-oxide varistor.
5. Mounting: Twist lock complies with ANSI C136.10, with base and stem mounting or stem and swivel mounting accessories as required to direct sensor to the north sky exposure.

B. Compatible with lighting control system.

2.6 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 26 0519 "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 Section 26 05 19 "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 Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.
- C. 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 systems, and partition assemblies.
- D. Install and aim sensors in locations to achieve not less than 95-percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 WIRING INSTALLATION

- A. Wiring Method: Comply with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 3/4inch.
- B. Wiring within Enclosures: 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.

3.3 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 26 05 53 "Identification for Electrical Systems."
- B. Label time switches and contactors with a unique designation.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Lighting control devices will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to four visits to Project during other-than-normal occupancy hours for this purpose.
 - 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
 - 2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.

3.6 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for four years.
- B. 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 60 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 26 09 23

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SECTION 26 24 16 - PANELBOARDS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Lighting and appliance branch-circuit panelboards.

1.2 DEFINITIONS

A. MCCB: Molded-case circuit breaker.

B. SPD: Surge protective device.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
6. Include wiring diagrams for power, signal, and control wiring.
7. Key interlock scheme drawing and sequence of operations.
8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

1.4 INFORMATIONAL SUBMITTALS

A. Panelboard schedules for installation in panelboards.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.6 FIELD CONDITIONS

- A. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

PART 2 PRODUCTS

2.1 PANELBOARDS COMMON 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. Comply with NEMA PB 1.
- C. Comply with NFPA 70.
- D. Enclosures: Flush and Surface-mounted, dead-front cabinets.
 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 2. Height: 84 inches maximum.
 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
- E. Incoming Mains Location: Top or Bottom as required for installation.
- F. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity.

- G. 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, with a lug on the neutral bar for each pole in the panelboard.
 - 3. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
 - 4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 - 5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
- H. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- I. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

2.2 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton.
 - 2. General Electric Company; GE Energy Management - Electrical Distribution.
 - 3. Siemens Industry, Inc., Energy Management Division.
 - 4. Square D; by Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or lugs as indicated on the drawings.
- 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.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton.
 - 2. General Electric Company; GE Energy Management - Electrical Distribution.
 - 3. Siemens Industry, Inc., Energy Management Division.
 - 4. Square D; by Schneider Electric.
- B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads.
 - b. Instantaneous magnetic trip element for short circuits.
 - c. 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:
 - a. RMS sensing.
 - b. Field-replaceable rating plug or electronic trip.
 - c. Digital display of settings, trip targets, and indicated metering displays.
 - d. Multi-button keypad to access programmable functions and monitored data.
 - e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
 - f. Integral test jack for connection to portable test set or laptop computer.
 - g. Field-Adjustable Settings:
 - 1) Instantaneous trip.

- 2) Long- and short-time pickup levels.
- 3) Long and short time adjustments.
- 4) Ground-fault pickup level, time delay, and I squared T response.
4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Subfeed Circuit Breakers: Vertically mounted.
9. MCCB Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Breaker handle indicates tripped status.
 - c. UL listed for reverse connection without restrictive line or load ratings.
 - d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
 - f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
 - h. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
 - i. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.4 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder.

2.5 ACCESSORY COMPONENTS AND FEATURES

- A. 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 INSTALLATION

- A. Comply with NECA 1.
- B. Install panelboards and accessories according to NEMA PB 1.1.
- C. Mount panelboard cabinet plumb and rigid without distortion of box.
- D. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- E. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- F. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- G. Install filler plates in unused spaces.
- H. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- I. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 26 05 53 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 26 05 53 "Identification for Electrical Systems" identifying source of remote circuit.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- 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 for low-voltage air circuit breakers stated in NETA ATS. 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.
- 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, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 26 24 16

SECTION 26 27 26 – WIRING DEVICES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Standard-grade receptacles, 125 V, 20 A.
2. GFCI receptacles, 125 V, 20 A.
3. Toggle switches, 120/277 V, 20 A.
4. Wall plates.

1.2 ACTION SUBMITTALS

- A. Product Data:** For each type of product.
- B. Shop Drawings:** List of legends and description of materials and process used for premarking wall plates.
- C. Samples:** One for each type of device and wall plate specified, in each color specified.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.**

PART 2 PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories:** Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Comply with NFPA 70.**
- C. RoHS compliant.**
- D. Comply with NEMA WD 1.**
- E. 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.

2. Wiring Devices Connected to Emergency Power System: Red

F. Wall Plate Color: For plastic covers, match device color.

G. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

A. Duplex Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
2. Description: Two pole, three wire, and self-grounding. Extra heavy duty grade.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498 and FS W-C-596.

B. Tamper-Resistant Duplex Receptacles, 125 V, 20 A:

1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Extra heavy duty grade.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498 and FS W-C-596.
4. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

C. Weather-Resistant Duplex Receptacle, 125 V, 20 A:

1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face. Extra heavy duty grade.

2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498.
4. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.

D. Tamper- and Weather-Resistant Duplex Receptacles, 125 V, 20 A:

1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face. Extra heavy duty grade.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498.
4. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.3 GFCI RECEPTACLES, 125 V, 20 A

A. Duplex GFCI Receptacles, 125 V, 20 A:

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Extra heavy duty grade.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Type: Non-feed through.
4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

B. Tamper-Resistant Duplex GFCI Receptacles, 125 V, 20 A:

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Extra heavy duty grade.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Type: Non-feed through.
4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

C. Tamper- and Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20 A:

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face. Extra heavy duty grade.
2. Configuration: NEMA WD 6, Configuration 5-15R.
3. Type: Non-feed through.
4. Standards: Comply with UL 498 and UL 943 Class A.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.4 TOGGLE SWITCHES, 120/277 V, 20 A

A. Single-Pole Switches, 120/277 V, 20 A:

1. Standards: Comply with UL 20 and FS W-S-896.

B. Two-Pole Switches, 120/277 V, 20 A:

1. Comply with UL 20 and FS W-S-896.

C. Three-Way Switches, 120/277 V, 20 A:

1. Comply with UL 20 and FS W-S-896.

D. Lighted Single-Pole Switches, 120/277 V, 20 A:

1. Description: Handle illuminated when switch is off.
2. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.

2.5 WALL PLATES

A. Single Source: Obtain wall plates from same manufacturer of wiring devices.

B. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.

2. Material for Finished Spaces: 0.035-inch-thick, satin-finished, Type 302 stainless steel.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
 1. 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.
 2. 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.
 3. Install wiring devices after all wall preparation, including painting, is complete.
- C. Device Installation:
 1. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
 2. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
- D. Receptacle Orientation:
 1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.
- E. 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.
- F. 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.

- G. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:

- 1. Test Instruments: Use instruments that comply with UL 1436.
- 2. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

- B. Tests for 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 unacceptable.
- 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.

- C. Wiring device will be considered defective if it does not pass tests and inspections.

- D. Prepare test and inspection reports.

END OF SECTION 26 27 26

SECTION 26 28 13 - FUSES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600 V ac and less for use in the following:
 - a. Enclosed controllers.
 - b. Enclosed switches.

1.2 ACTION SUBMITTALS

- A. Product Data:** For each type of product.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.**

1.4 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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

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. Bussmann, an Eaton business.
 2. Edison; a brand of Bussmann by Eaton.
 3. Littelfuse, Inc.
 4. Mersen USA.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
 - 1. Type RK-5: 250-V, zero- to 600-A rating, 200 kAIC, time delay.
 - 2. Type J: 600-V, zero- to 600-A rating, 200 kAIC.
 - 3. Type L: 600-V, 601- to 6000-A rating, 200 kAIC.
- 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 NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinets in location shown on the Drawings.

3.2 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 26 28 13

SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Enclosures.

1.2 ACTION SUBMITTALS

- A. Product Data:** For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
- B. Shop Drawings:** For enclosed switches and circuit breakers.
1. Include plans, elevations, sections, details, and attachments to other work.
 2. Include wiring diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data:** For qualified testing agency.
- B. Seismic Qualification Certificates:** For enclosed switches and circuit breakers, accessories, and components, from manufacturer.
- C. Field quality-control reports.**

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.**

1.5 WARRANTY

- A. Manufacturer's Warranty:** Manufacturer and Installer agree to repair or replace components 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 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed switches and circuit breakers 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."

2.2 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- B. 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.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with NFPA 70.

2.3 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton.
 - 2. General Electric Company.
 - 3. Siemens Industry, Inc., Energy Management Division.
 - 4. Square D; by Schneider Electric.
- B. Type HD, Heavy Duty:
 - 1. Single throw.
 - 2. Three pole.
 - 3. 600-V ac.

4. 1200 A and smaller.
5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses.
6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. 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; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.

2.4 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. General Electric Company.
3. Siemens Industry, Inc., Energy Management Division.
4. Square D; by Schneider Electric.

B. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. 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; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.

4. Service-Rated Switches: Labeled for use as service equipment.

2.5 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: The enclosure shall be gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1) or gray baked enamel paint, electrodeposited on cleaned, phosphatized galvanized steel (NEMA 250 Types 3R, 12).
- C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.
- D. Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.
- E. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

PART 3 EXECUTION

3.1 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 2. Outdoor Locations: NEMA 250, Type 3R.
 3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
 4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

3.2 INSTALLATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Install fuses in fusible devices.
- D. Comply with NFPA 70 and NECA 1.
- E. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 05 73.16 "Coordination Studies."

3.3 IDENTIFICATION

- A. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
- B. Tests and Inspections for Switches:
 - 1. Visual and Mechanical Inspection:
 - a. Inspect physical and mechanical condition.
 - b. Inspect anchorage, alignment, grounding, and clearances.
 - c. Verify that the unit is clean.
 - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
 - e. Verify that fuse sizes and types match the Specifications and Drawings.
 - f. Verify that each fuse has adequate mechanical support and contact integrity.

- g. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
 - h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
 - i. Verify correct phase barrier installation.
 - j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
2. Electrical Tests:
- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.

- d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
 - e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."
- C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.
 - 1. Test procedures used.
 - 2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
 - 3. List deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 26 28 16

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SECTION 26 51 19 – LED INTERIOR LIGHTING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior lighting fixtures, lamps, ballasts, LEDs and drivers.
2. Lighting fixture supports.

1.2 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color-rendering index.
- C. LED: Light emitting diode.
- D. LER: Luminaire efficacy rating.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.3 ACTION 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. Arrange in order of luminaire designation.
 2. Include data on features, accessories, and finishes.
 3. Include physical description and dimensions of luminaires.
 4. Include emergency lighting units, including batteries and chargers.
 5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
 6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.

- a. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

1.4 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. Lighting fixtures.
 2. Suspended ceiling components.
 3. Partitions and millwork that penetrate the ceiling or extends to within 12 inches of the plane of the luminaires.
 4. Ceiling-mounted projectors.
 5. Structural members to which suspension systems for lighting fixtures will be attached.
 6. Other items in finished ceiling including the following:
 - a. Air outlets and inlets.
 - b. Sprinklers.
 - c. Smoke and heat detectors.
 - d. Occupancy sensors.
 - e. Access panels.
- B. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.
- C. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, from manufacturer.
- D. Field quality-control reports.
- E. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

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. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Plastic Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. LED-fixture-mounted, emergency battery pack: One for every 50 emergency lighting unit.

1.7 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. 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 NFPA 70.
- D. Provide luminaires from a single manufacturer for each luminaire type.

1.8 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.

1.9 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

- B. Warranty Period: Five years from date of Substantial Completion.
- C. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Emergency Lighting Unit Batteries: 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, product(s) indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Metal Parts: Free of burrs and sharp corners and edges.
- C. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
- D. 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.
- E. Diffusers 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 minimum unless otherwise indicated.
 - b. UV stabilized.
 - 2. Glass: Annealed crystal glass unless otherwise indicated.

F. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and drivers. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and LED driver characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. CCT and CRI for all luminaires.

2.3 LED DRIVERS AND POWER SUPPLIES

A. Description: Electronic solid state type.

1. Ten-year operational life while operating at maximum case temperature and 90 percent non-condensing relative humidity.
2. Designed and tested to withstand electrostatic discharges up to 15,000
3. Electrolytic capacitors shall operate at least 20 degrees C below the capacitor's maximum temperature rating when the driver is under fully-loaded conditions and under maximum case temperature.
4. Maximum inrush current of 2 amperes for 120V and 277V drivers.
5. Withstand up to a 4,000 volt surge without impairment of performance as defined by ANSI C62.41 Category A.
6. Manufactured in a facility that employ ESD reduction practices in compliance with ANSI/ESD S20.20.
7. Inaudible in a 27 dBA ambient.
8. No visible change in light output with a variation of plus/minus 10 percent line voltage input.
9. Total Harmonic Distortion less than 20 percent and meet ANSI C82.11 maximum allowable THD requirements.
10. Drivers shall track evenly across multiple fixtures and all light levels.
11. Constant current drivers shall provide models shall support from 200mA to 2.1Amps (in 10mA steps) to ensure a compatible driver exists and support LED arrays up to 40W.

12. Constant voltage drivers shall provide models to support from 10Volts to 40Volts (in 0.5V steps) to ensure a compatible driver exists and support LED arrays up to 40W.
13. Configuration tool shall be available to optimize light level, efficacy, and thermal performance for LED fixtures.
14. Driver shall be capable of operating from a supply voltage of 120 through 277VAC at 60Hz for 3-wire models.

2.4 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

- A. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70 and UL 924, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- B. Comply with NFPA 101.
- C. Comply with NEMA LE 4 for recessed luminaires.
- D. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body.
 1. Emergency Connection: Operate lamps continuously at an output of lumens as indicated in Luminaire Schedule upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast.
 2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 3. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.
 - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 4. Battery: Sealed, maintenance-free.
 5. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.

2.5 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Section 26 05 29 "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 steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch 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 gauge.
- E. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- F. 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 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 luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.

3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaires:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

F. Wall-Mounted Luminaires:

1. Attached to a minimum 20 gauge backing plate attached to wall structural members or attached using through bolts and backing plates on either side of wall.
2. Do not attach luminaires directly to gypsum board.

G. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

H. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.3 IDENTIFICATION

- A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.

1. Adjust aimable luminaires in the presence of Contracting Officer.

END OF SECTION 26 51 19

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SECTION 26 52 13 – EMERGENCY AND EXIT LIGHTING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Emergency lighting units.
2. Exit signs.
3. Luminaire supports.

1.2 DEFINITIONS

- A. CCT:** Correlated color temperature.
- B. CRI:** Color Rendering Index.
- C. Emergency Lighting Unit:** A lighting unit with integral or remote emergency battery powered supply and the means for controlling and charging the battery and unit operation.
- D. Fixture:** See "Luminaire" Paragraph.
- E. Lumen:** Measured output of lamp and luminaire, or both.
- F. Luminaire:** Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

- A. Product Data:** For each type of emergency lighting unit, exit sign, and emergency lighting support, arranged by designation.
- B. Shop Drawings:** For nonstandard or custom luminaires.
1. Include plans, elevations, sections, and mounting 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. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of luminaire.
- B. Sample Warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.6 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two year(s) from date of Substantial Completion.
- B. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

- 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. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.
- C. Comply with NFPA 70 and NFPA 101.
- D. Comply with NEMA LE 4 for recessed luminaires.
- E. Comply with UL 1598 for recessed luminaires.
- F. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body.
 - 1. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage

is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

2. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Less than 0 degrees F or exceeding 104 degrees F, with an average value exceeding 95 degrees F over a 24-hour period.
 - b. Ambient Storage Temperature: Not less than minus 4 degrees F and not exceeding 140 degrees F.
 - c. Humidity: More than 95 percent (condensing).
 - d. Altitude: Exceeding 3300 feet.
3. Test Push-Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
 - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
4. Battery: Sealed, maintenance-free, nickel-cadmium type.
5. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.

2.2 EMERGENCY LIGHTING

- A. General Requirements for Emergency Lighting Units: Self-contained units.
- B. Emergency Luminaires: As scheduled

2.3 EXIT SIGNS

- A. Internally Lighted Signs: As Scheduled
 1. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.

2.4 MATERIALS

- A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access:

1. Smooth operating, free of light leakage under operating conditions.
2. Designed to permit relamping without use of tools.
3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Housings: As scheduled

D. Conduit: Electrical metallic tubing, minimum 3/4 inch in diameter.

2.5 METAL FINISHES

- A. Appearance of Finished Work:** Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.**

PART 3 EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.**
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.**
- C. Install lamps in each luminaire.**
- D. Supports:**
1. Sized and rated for luminaire and emergency power unit weight.

2. Able to maintain luminaire position when testing emergency power unit.
3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of fixture weight.

E. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.
2. Do not attach fixtures directly to gypsum board.

F. Suspended Luminaire Support:

1. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of fixture oscillations. Support outlet box vertically to building structure using approved devices.
2. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

G. Ceiling Grid Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.

H. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 26 52 13

SECTION 28 05 14 – FIRE ALARM CABLES AND CONDUCTORS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes fire-alarm cables and conductors.
- B. Related Requirements:
 - 1. Section 26 05 19 “Low-Voltage Electrical Power Conductors and Cables.”

1.2 DEFINITIONS

- A. Building Control Circuits: As defined in NFPA 70, Article 725 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- B. CI: Circuit Integrity.
- C. Fire Alarm Circuit Integrity Cable: Cable used in fire alarm systems to ensure continued operation of critical circuits during a specified time under fire conditions.
- D. IDC: Initiating Device Circuit.
- E. NPLFA: Non-Power Limited Fire Alarm.
- F. PLC: Power Limited Circuit
- G. PLFA: Power-Limited Fire Alarm
- H. SLC: Signaling Line Circuit

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: Indicate type, use, location, and termination locations.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.
- B. Source quality-control reports.

- C. Field quality-control reports.

PART 2 PRODUCTS

2.1 FIRE-ALARM WIRE AND CABLE

- 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. Allied Wire & Cable Inc.
2. CommScope, Inc.
3. Genesis Cable Products; Honeywell International, Inc.
4. West Penn Wire.

- B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

- C. Signaling Line Circuits: Solid-copper twisted, shielded pair, 16 AWG minimum.

- D. Notification Appliance Circuits:

1. Strobe circuits must be 14 AWG minimum.

- E. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.

1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.

PART 3 EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Power-Limited Fire Alarm and Control Circuits: Solid copper. Stranded wiring must not be used.

3.2 INSTALLATION, GENERAL

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

- B. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for installation of conduit and cable support devices.
- C. Complete raceway installation between conductor and cable termination points according to Section 26 05 33 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- D. 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.
- E. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- F. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

3.3 INSTALLATION OF FIRE-ALARM CABLES AND CONDUCTORS

- A. Comply with NECA 1 and NFPA 72.
- B. Wiring Method: All fire alarm cables and conductors must be installed in metal pathway.
 - 1. Conduit must be rigid metal or electrical metallic tubing.
 - 2. Minimum conduit size: Trade size 3/4-inch inside diameter.
 - 3. Compression fittings must be used.
 - 4. Fire-alarm circuits and equipment control wiring associated with fire-alarm system must be installed in a dedicated pathway system.
 - a. Cables and pathways used for fire-alarm circuits, and equipment control wiring associated with fire-alarm system, may not contain any other wire or cable.
 - 5. Signaling Line Circuits: Power-limited fire-alarm cables may be installed in the same pathway as signaling line circuits when permitted by the alarm manufacturer.
- C. Wiring within Enclosures:
 - 1. Separate power-limited and non-power-limited conductors as recommended by manufacturer.

2. Install conductors parallel with or at right angles to sides and back of the enclosure.
 3. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
 4. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire-alarm system to terminal blocks.
 5. Mark each terminal according to system's wiring diagrams.
 6. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes; cabinets; or equipment enclosures where circuit connections are made.
- E. All cable runs shall be continuous between devices without splices.
1. All terminations of conductors shall be to screw-type terminal blocks. Wire nuts, wrap-on, crimp connectors and similar devices shall not be permitted.
 2. All connections shall be accessible for inspection and servicing and shall be clearly identified on the Contractor's record drawings.
- F. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.
- G. Wiring to Remote Alarm Transmitting Device: 1-inch conduit between the fire-alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.4 POWER AND CONTROL-CIRCUIT CONDUCTORS

- A. 120-V Power Wiring: Install according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" unless otherwise indicated.
- B. Minimum Conductor Sizes:
1. Class 1 remote-control and signaling circuits, No. 14 AWG.
 2. Class 2 low-energy, remote-control and signal circuits, No. 14 AWG.

3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

3.5 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-486B.
- B. Make terminations and taps that are compatible with conductor material.
- C. Comply with requirements in Section 28 31 11 "Addressable Fire Alarm System with One-Way Emergency Voice/Alarm Communications System" for connecting, terminating, and identifying wires and cables.

3.6 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 26 05 53 "Identification for Electrical Systems."

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 Section 07 84 13 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

- A. Administrant for Tests and Inspections:
 1. Administer and perform tests and inspections.
- B. Tests and Inspections:
 1. Perform each of the following visual and electrical tests:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - b. Inspect for correct identification.
 - c. Inspect cable jacket and condition.
 - d. Continuity test on each conductor and cable.
- C. Cables will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 28 05 14

SECTION 28 46 21 - ADDRESSABLE FIRE ALARM SYSTEM WITH ONE-WAY EMERGENCY VOICE ALARM COMMUNICATIONS SYSTEM

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-alarm control unit (FACU) with voice/alarm signaling service module for in-building one-way fire emergency voice/alarm communications system (EVACS).
2. Manual fire-alarm boxes (pull stations).
3. System smoke detectors.
4. Heat detectors.
5. Fire-alarm notification appliances with voice/alarm signaling loudspeakers.
6. Remote annunciator and graphic map.
7. Addressable interface devices.
 - a. Control relays.
 - b. Monitoring relays.
8. Digital alarm communicator transmitter.
9. Cellular Dialer.
10. Fire alarm system surge protective devices.
11. Fire alarm system document storage box (cabinet).

B. Related Requirements:

1. Section 08 71 00 "Door Hardware" for door hold open devices.
2. Section 28 05 14 "Fire Alarm Cables and Conductors" for cables and conductors for fire-alarm systems.
3. Division 7 section for firestopping requirements.

- C. Fire alarm system shall be designed and installed by a company licensed by the Office of the Delaware State Fire Marshal.
 - 1. Refer to the Office of the Delaware State Fire Marshal website for the list of current licensed fire alarm companies. <https://statefiremarshal.delaware.gov/plan-review-and-inspections/licensed-public-fire-protection-companies-testing-applications/>.
 - 2. Formal plan submittal and approval is required prior to installation.
- D. Obtain and pay for permits required for the installation of the fire alarm system.
 - 1. Fire alarm contractor must provide shop drawing submittal documents to the AHJ to obtain permit. Submittal must include, but not be limited to all of the following:
 - a. Scaled floor plans with room names and numbers which indicate the use of all rooms.
 - b. Fire alarm device and cable symbol legend.
 - c. Locations, including mounting heights of alarm-initiating and notification appliances.
 - d. Alarm control and trouble signaling equipment.
 - e. Fire alarm control panel and annunciator locations.
 - f. Power connections.
 - g. Battery calculations.
 - h. Size, type and number of conductors.
 - i. Voltage drop calculations.
 - j. Manufacturer's data sheets including model numbers and listing information for equipment, devices and materials.
 - k. Details of ceiling height and construction.
 - l. The interface of fire safety control functions.
 - m. Fire alarm system riser diagram.
 - n. Device-to-device wiring.

- o. Loudness and candela settings for every notification appliance.

1.2 DEFINITIONS

- A. AGM: Absorbed Glass Mat.
- B. ECS: Emergency Communications System.
- C. EMT: Electrical Metallic Tubing.
- D. EVACS: Emergency Voice/Alarm Communications System.
- E. FACP: Fire Alarm Control Panel.
- F. FACU: Fire Alarm Control Unit.
- G. FAID: Fire Alarm Initiating Device.
- H. HLI: High Level Interface.
- I. LCD: Liquid Crystal Display.
- J. LED: Light-Emitting Diode.
- K. NICET: National Institute for Certification in Engineering Technologies.
- L. PC: Personal Computer.
- M. VRLA: Valve Regulated Lead Acid.

1.3 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 the requirements and recommendations in the "Shop Drawings (Installation Documentation)" section of the "Documentation" chapter in NFPA 72. Items to be provided include, but are not limited to the following:

- a. Date of issue and any revision dates.
- b. List of applicable codes and standards, including editions.
- c. Name of protected premises, Owner, and occupant.
- d. Name of installer and contractor.
- e. Location (street address) of protected premises.
- f. Plans, elevations, sections, details, and attachments to other work.
- g. Details of equipment assemblies and support requirements. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations.
- h. Indicate conductor sizes, termination locations and requirements, and distinguish between factory and field wiring.
- i. Assembly and support requirement details.
- j. Voltage-drop calculations for notification-appliance circuits.
- k. Battery-size calculations.
- l. Input/output matrix.
- m. 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.
- n. Performance parameters and installation details for each detector.
- o. Verification that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
- p. Emergency voice/alarm communications system signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
- q. Legend for fire alarm device symbols and cable.
- r. Floor plans:

- 1) Drawn to an indicated scale.
- 2) Include the following information:
 - a) Floor or level identification.
 - b) Point of compass. (north arrow).
 - c) Graphic scale.
 - d) All walls and doors.
 - e) All partitions extending to within 15 percent of the ceiling height.
 - f) Identification of any ceiling over 10 feet in height where automatic fire detection is being proposed.
 - g) Details of ceiling geometries, including beams and solid joists, where automatic fire detection is being proposed.
 - h) Room names and numbers which indicate the use of all rooms.
 - i) System devices and component locations showing address of each addressable device.
 - j) Type, size and quantity of conductors and conduit for each circuit.
 - k) Route of cable and conduits.
 - l) Locations of system's primary disconnecting means.
 - m) Locations of monitor control interfaces to other systems.
 - n) System riser locations.
 - o) Point-to-point wiring.
 - p) Pathway class designations, including the location of any end-of-line supervisory or power devices that are required by the pathway class.
 - q) Pathway survivability level designations.

- s. Fire alarm system riser diagram with the following information coordinated with the floor plans:
 - 1) General arrangement of the system in building cross-section.
 - 2) Device-to-device wiring.
 - 3) Number of risers.
 - 4) Type and number of circuits in each riser.
 - 5) Type and number of system components and devices on each circuit on each floor or level.
 - 6) Number of conductors for each circuit.
 - 7) Pathway class designations, including the location of any end-of-line supervisory or power devices that are required by the pathway class.
 - 8) Pathway survivability level designations.

C. General Submittal Requirements:

- 1. Submittals must be approved by authorities having jurisdiction prior to submitting them to Engineer.
- 2. Shop Drawings must be prepared by persons with the following qualifications:
 - a. NICET-certified, fire-alarm technician; Level IV minimum or a Licensed Fire Protection Engineer.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

- 1. NICET Level III certificate or professional fire protection engineer license.

B. Field quality-control reports.

C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
- B. Completion Documentation: In addition to items specified in Section 017823 "Operating and Maintenance Data and Instructions," provide documentation in accordance with the "Completion Documentation" section of the "Documentation" chapter in NFPA 72. Items to be provided include, but are not limited to the following:
 - 1. Written statement stating that the system has been installed in accordance with approved plans and tested in accordance with the manufacturer's published instructions and the appropriate NFPA requirements.
 - 2. Record of Completion: "Fire Alarm System Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" section of the "Inspection, Testing, and Maintenance" Chapter.
 - 3. Record (As-Built) Drawings. Submit two full-size copies to the Owner. Items to be provided include, but are not limited to the following:
 - a. Current updated shop drawings reflecting the actual installation of all system equipment, components, and wiring.
 - b. Complete wiring diagrams showing connections between all devices and equipment. Each conductor must be numbered at every junction point with indication of origination and termination points.
 - c. Riser diagram.
 - d. Device addresses.
 - 4. Record Copy of Site-Specific Software. Provide Software and Firmware Operational Documentation:
 - a. Software operating and upgrade manuals.
 - b. Program Software Backup: On magnetic media or compact disk, complete with data files.
 - c. Device address list.
 - d. Printout of software application and graphic screens.

5. Verification of Compliant Installation.
 6. Documentation of central station service.
- C. Inspection, Testing, and Maintenance Documentation: Comply with the "Inspection, Testing and Maintenance" section in the "Documentation" chapter and the "Inspection, Testing and Maintenance" chapter in NFPA 72. Items to be provided include, but are not limited to the following:
1. Test plan documentation.
 2. Acceptance testing documentation.
 3. Periodic inspection and testing documentation.
 4. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
 - a. Equipment to be tested.
 - b. Frequency of testing of installed components.
 - c. Frequency of inspection of installed components.
 - d. Requirements and recommendations related to results of maintenance.
 - e. Manufacturer's user training manuals.
 5. Manufacturer's required maintenance related to system warranty requirements.
 6. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Keys: Provide six sets of keys to all locks at occupancy.
1. Properly and legibly mark and tag each set of keys. Loose keys will not be accepted.
 2. Transmit keys to Facilities Management Manager [and Life Safety Manager] for acceptance at occupancy.

B. 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 and Heat 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 tamper-proofed 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.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Fire alarm system must be installed under the supervision of persons with the following minimum qualifications:
 - a. Certified by NICET as fire-alarm Level III technician.
2. Personnel must be trained and certified by manufacturer for installation of units required for this project.

B. Source Limitations for Fire Alarm System and Components: Obtain fire alarm system from single source from single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.8 PROJECT CONDITIONS

- A. Protect devices during construction. If devices are placed in service to protect the facility during construction, replace devices prior to final acceptance.

1.9 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: One year from date of Substantial Completion.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Noncoded, addressable system, with multiplexed signal transmission and voice/strobe evacuation.
- B. Automatic sensitivity control of certain smoke detectors.
- C. All components provided must be listed for use with the selected system.
- D. 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 must be by one or more of the following devices and systems:
 - 1. Manual fire alarm boxes.
 - 2. Heat detectors.
 - 3. Smoke detectors.
- B. Fire-alarm signal must 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. Activate voice/alarm communication system.
 5. Release fire and smoke doors, and other designated doors held open by magnetic and electromechanical door holders.
 6. Activate emergency lighting control.
 7. Mute audiovisual sound systems.
 8. Record events in the system memory.
 9. Indicate device in alarm on the remote annunciator.
- C. Supervisory signal initiation must be by one or more of the following devices and actions:
1. Emergency Responder Communications Enhancement System (ERCES)
 - a. Radio System
 - 1) Donor antenna malfunction.
 - 2) Active RF emitting device failure.
 - 3) Low-battery capacity indication when 70 percent of the 12-hour operating capacity has been depleted.
 - 4) System component failure.
 - b. Bi-Directional Amplifier Power Supply
 - 1) Loss of normal ac power.
 - 2) Failure of battery charger.
 2. User disabling of zones or individual devices.

3. Loss of communication with any panel on the network.
- D. System trouble signal initiation must 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 and Trouble Signal Actions:
1. Initiate notification appliances.
 2. Identify specific device initiating the event at fire-alarm control unit and remote annunciators.
 3. Transmit a trouble or supervisory signal to the remote alarm receiving station.
 4. Display system status on graphic annunciator and remote annunciator.
 5. Record the event in system memory.

2.3 FIRE-ALARM CONTROL UNIT

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:

1. Gamewell - FCI by Honeywell.
 2. Mircom Technologies, Ltd.
 3. Notifier.
 4. Potter Electric Signal Company, LLC. Siemens Industry, Inc.; Fire Safety Division.
 5. Silent Knight.
 6. SimplexGrinnell LP
- B. Description: Field-programmable, microprocessor-based, modular, power-limited design with electronic modules.
- C. Performance Criteria:
1. Regulatory Requirements: Comply with NFPA 72 and UL 864.
 2. General Characteristics:
 - a. System software and programs must 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 FACU and remote circuit interface panels, annunciators, and displays.
 - d. The FACU must 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 must require no manual input to initialize in the event of a complete power down condition. The FACU must provide a minimum 500-event history log.
 - f. Addressable Initiation Device Circuits: The FACU must indicate which communication zones have been silenced and must provide selective silencing of alarm notification appliance by building communication zone.

- 1) Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment.
3. 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.
 - a. Annunciator and Display: Liquid-crystal type, three line(s) of 80 characters, minimum.
 - b. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.
4. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
 - a. NFPA 72 Pathway Class Designations:
 - 1) Initiating-Device Circuits (monitoring non-intelligent devices) – Class B.
 - a) Addressable monitoring modules must be located within three feet of the non-intelligent device they monitor.
 - 2) Notification-Appliance Circuits – Class B.
 - 3) Signaling-Line Circuits - Class A.
 - b. Pathway Survivability: Level 0.
 - c. Install no more than 159 addressable detectors and 159 addressable monitor, control, or relay devices on each signaling-line circuit.
 - d. Visual alarm appliances must flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.
5. Serial Interfaces are required for the following:
 - a. Central-station operation using point ID DACT.
 - b. Remote annunciators,

c. EVACS interface.

d. PC configuration.

D. Notification Appliance Circuit:

1. Audible appliances must sound in a three-pulse temporal pattern, as defined in NFPA 72.
2. Visual alarm appliances must flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

E. Remote Smoke-Detector Sensitivity Adjustment: Controls must 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.

F. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

G. Voice/Alarm Signaling Service: Central EVACS with preamplifiers, amplifiers, and tone generators provided in a separate cabinet. Locate cabinet adjacent to FACU in the electrical room on Level 01.

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 must 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.
 - 1) Fire alarm evacuation message must consist of ANSI S3.41 standard "three pulse temporal" alert for two cycles, followed by the voice evacuation message, followed by two cycles of the alert tone. This process must continue until the alarm condition has been cleared, the system has been reset, or the alarm is manually silenced.

- 2) A live voice message must override the automatic output.
- c. The system must be capable of operating all loudspeakers at the same time.
- d. Standard digitally recorded messages for "Evacuation" and "All Clear."
- e. 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.
- f. The digitalized voice message must consist of a non-volatile microprocessor-based input to the amplifiers. The microprocessor must actively interrogate all circuitry, field wiring and digital coding necessary for the immediate and accurate rebroadcasting of the stored voice data into the appropriate amplifier input. Loss of operating power, supervisory power, or any other malfunction, which could render the digital voice module inoperable must automatically cause the standard temporal alert tone to take over all functions assigned to the failed unit.
- g. Messages must be approved by the Authority Having Jurisdiction (AHJ). The prerecorded messages shall include, but not be limited to the following:

**“May I have your attention please! May I have your attention please!
There has been a fire alarm reported in the building. Please proceed to
the nearest exit and leave the building.”**
- 2. Status Annunciator: Indicate the status of various voice/alarm loudspeaker zones and the status of firefighters' two-way telephone communication zones.
- 3. Preamplifiers, amplifiers, and tone generators must automatically transfer to backup units, on primary equipment failure.
- H. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters must be powered by 24-V dc source.
 - 1. Alarm current draw of entire fire-alarm system must not exceed 80 percent of the power-supply module rating.
- I. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Secondary battery power must be capable of operating the system under quiescent load for a minimum of 24 hours and then must be capable of operating the system during a fire or other emergency condition for a period of 15 minutes at maximum connected load.
 2. Batteries: VRLA-AGM: Valve-regulated, absorbed glass mat, lead acid. Batteries must be housed in the control cabinet or a separate cabinet with adequate cell separation to prevent accidental discharge.
 3. The charger must be automatic in design, adjusting the charge rate to the condition of the batteries. Battery charger must be housed in the main fire alarm control panel or the battery cabinet.
 4. Battery and Charger Capacity: Comply with NFPA 72. The battery supply must be calculated to operate its load under quiescent load for twenty-four hours with no primary power applied and, after that time, operate during a fire or other emergency condition for a period of fifteen minutes at maximum connected load. Batteries must be sized with an added 20% safety margin to allow for deterioration and aging during the life of the battery. Battery calculations must be submitted to justify the battery size.
- J. 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.

2.4 SURGE PROTECTION

- A. Install surge protection on normal ac power for the FACP, Auto-Dialer, Booster/NAC Panels, Amplifiers and its accessories. Comply with Division 26 Section "Surge Protective Devices for Low-Voltage Electrical Power Circuits" for auxiliary panel suppressors.
1. Surge suppressors must be listed for use with fire alarm systems.
 2. Install surge suppressors adjacent to fire alarm equipment cabinet(s). Do not install surge suppressors inside fire alarm equipment cabinets.
- B. Install surge protection on all system wiring that leaves the interior premises of the building housing the FACU.
- C. Provide surge suppressors for all telephone or DSL connections to the fire alarm system.

2.5 MANUAL FIRE-ALARM BOXES (MANUAL PULL STATIONS)

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes must be finished in red with molded, raised-letter operating instructions in contrasting color; must show visible indication of operation; and must 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.

2.6 SYSTEM SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:
1. Comply with UL 268; operating at 24-V dc, nominal.
 2. Detectors must be four-wire type.
 3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
 4. Base Mounting: Detector and associated electronic components must be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
 5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 6. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
 7. Remote Viewing: Unless otherwise indicated, detectors must be digital-addressable type, individually monitored at fire-alarm control unit for, sensitivity, and alarm condition
- B. Photoelectric Smoke Detectors:
1. Detector address must be accessible from fire-alarm control unit and must be able to identify the detector's location within the system and its sensitivity setting.

2.7 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

1. Temperature sensors must 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 or a rate of rise that exceeds 15 deg F 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.

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: 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.

B. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "ALERT" is engraved in minimum 1-inch-high letters on the lens.

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 must be determined with guards in place.
4. Flashing must be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, [red] [white].

C. Voice Signal Notification Appliances:

1. Comply with UL 1480.
2. Loudspeakers for Voice Notification: Locate loudspeakers 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, semi-recessed, or surface mounted and bidirectional as required by location and field conditions.
6. Matching Transformers: Tap range matched to acoustical environment of loudspeaker location.

2.9 GRAPHIC MAP

- A. Graphic Map: Mounted in an aluminum frame with nonglare, minimum 3/16-inch-thick, clear acrylic cover over graphic representation of the facility.
1. Graphic representation of the facility must be a CAD drawing. CAD drawing must be at 1/16-inch per foot scale or larger.
 2. Locate graphic map at fire department entrance, adjacent to the remote annunciator.
 3. The orientation of the graphic map must be oriented to the viewing angle of the reader.

2.10 REMOTE ANNUNCIATOR

- A. Description: Annunciator functions must match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions must match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
 - 1. Mounting: Surface cabinet, NEMA 250, Type 1.
- B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights must match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.11 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.

2.12 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Digital alarm communicator transmitter must be acceptable to the remote central station and must comply with UL 632.
- B. Functional Performance: Unit must 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 must be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter must 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 must automatically report telephone service restoration to

the central station. If service is lost on both telephone lines, transmitter must initiate the local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter must 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.

D. Digital data transmission must 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.

E. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.13 FIRE-ALARM CELLULAR DIALER

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. Telular Corp. Telguard TG-7FS.

2. StarLink Fire LTE

B. Performance Criteria:

1. Regulatory Requirements:

- a. NFPA 72.
- b. UL 864.

2. General Characteristics:

- a. Must be factory assembled, wired, and tested; ready for installation and operation.
- b. Packaging: Single, modular, NEMA 250, Type 1 metal enclosure with tamper-resistant flush tumbler lock.
- c. Normal Power Input: 120 V(ac).
- d. Secondary Power: Integral-sealed, rechargeable, 12 V battery and charger. Comply with NFPA 72 requirements for battery capacity; submit calculations.
 - 1) Alarm Interface Devices: Circuit boards, modules, and other auxiliary devices, integral to transmitter, matching fire-alarm and other system outputs to message-generating inputs of transmitter that produce required message transmissions.
- e. Functional Performance: Unit must receive alarm, supervisory, or trouble signal from FACU or from its own internal sensors or controls and must automatically transmit signal along with unique code that identifies transmitting station to remote alarm receiving station. Transmitted messages must correspond to standard designations for fire-reporting system to which signal is being transmitted and must include separately designated messages in response to the following events or conditions:
 - 1) Dialer Low-Battery Condition: Sent when battery voltage is below 85 percent of rated value.
 - 2) System Test Message: Initiated manually by test switch within transmitter cabinet, or automatically at optionally preselected time,

once every 24 hours, with transmission time controlled by programmed timing device integral to transmitter controls.

- 3) Transmitter Trouble Message: Actuated by failure, in excess of one-minute duration, of transmitter normal power source, derangement of wiring of transmitter, or alarm input interface circuit or device connected to it.
- 4) Local Fire-Alarm-System Trouble Message: Initiated by events or conditions that cause trouble signal to be indicated on building system.
- 5) Local Fire-Alarm-System Alarm Message: Actuated when building system goes into alarm state. Identifies device that initiated alarm.
- 6) Local Fire-Alarm-System, Supervisory-Alarm Message: Actuated when building alarm system indicates supervisory alarm.

2.14 DOCUMENT STORAGE BOX (CABINET)

- A. Description: Enclosure to accommodate standard 8-1/2-by-11-inch manuals and loose document records. Legend sheet must be permanently attached to cabinet door for system required documentation, key contact personnel, and system information. Provide two key ring holders with location to mount standard business cards for key contact personnel.
 1. Size documentation cabinet so that all necessary documentation will fit inside it.
 2. Documentation includes, but is not limited to Owner's manual, record drawings, record of completion form, equipment technical and product data sheets, emergency response plan, record copy of site-specific software and firmware control documentation, annual inspection testing and maintenance records, etc.
- B. Material and Finish: 18-gauge cold-rolled steel; four mounting holes.
- C. Color: Red powder-coat epoxy finish.
- D. Labeling: Permanently screened with 1-inch-high lettering "SYSTEM RECORD DOCUMENTS" with white indelible ink.
- E. Security: Locked with 3/4-inch barrel lock. Provide solid 12-inch stainless steel piano hinge.

2.15 DOOR HOLD OPENS

- A. Door hold open devices will be furnished with door hardware.

2.16 CABLES AND CONDUCTORS

- A. Cables and conductors for fire alarm systems must be UL listed and labeled as complying with NFPA 70, Article 760.

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 INSTALLATION OF EQUIPMENT

- A. Comply with NECA 305, NFPA 70, NFPA 72, NFPA 101, IBC, 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 installed but not yet placed in service must 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 above the finished floor.
- C. Manual Fire-Alarm Boxes:
 - 1. Install manual fire-alarm box in the normal path of egress within 60 inches 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 must be between 42 inches and 48 inches above floor level. All devices must 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. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas must be determined according to Annex A or Annex B in NFPA 72.
 4. HVAC: Locate detectors not closer than 36 inches from air-supply diffuser or return-air opening.
 5. 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 must remain in place except during system testing. Remove cover prior to system turnover.
- F. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, and valve-tamper switch that is not readily visible from normal viewing position.
- G. Audible Alarm-Indicating Devices: Install not less than 6 inches 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.
- H. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.3 PATHWAYS

- A. Pathways above recessed ceilings and in non-accessible locations may be routed exposed.
 - 1. Exposed pathways located less than 96 inches above the floor must be installed in EMT.
- B. Pathways must be installed in EMT.

3.4 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 28 05 15 "Fire Alarm Cables and Conductors."
- B. Ground equipment in accordance with Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
 - 1. Nameplate must be laminated acrylic or melamine plastic signs, as specified in Section 26 05 53 "Identification for Electrical Systems."

3.5 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions, and related to doors in smoke partitions, 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 from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
 - 1. Magnetically and electromechanically held open doors.
 - 2. Supervisory connections at valve supervisory switches.

- C. Identify system components, wiring, cabling, and terminals.

3.6 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.
- C. Provide fire alarm control panel circuit breaker with red marking in accordance with NFPA 72. Fasten phenolic nameplate at circuit breaker. Nameplate must read: "FIRE ALARM CIRCUIT."
- D. Identify power source and location of branch circuit disconnect serving fire alarm equipment. Provide engraved phenolic sign fastened to FACP "THIS PANEL FED FROM PANEL ____, CIRCUIT NO. _____.LOCATED IN _____"

3.7 GROUNDING AND BONDING

- A. Ground FACU and associated circuits in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.8 FIELD QUALITY CONTROL

- A. Field tests must be witnessed by authorities having jurisdiction.
- B. Test and inspect components, assemblies, and equipment installations, including connections.
- C. Tests and inspections:
 - 1. Prepare for final test. Ensure all components of the project's fire protection systems are inspected and pre-tested prior to requesting a final inspection visit by the AHJ. Inspection deficiencies will be referenced to NFPA requirements, and/or Contract Specification requirements. Use, as a minimum, the following pre-commissioning check list:
 - ☐ NFPA 72" Fire Alarm System Record of Completion" form completed by contractor.

- ☐ System meets contract specification requirements
- ☐ O&M Manuals provided
- ☐ System has been inspected and pre-tested
- ☐ Proper batteries installed
- ☐ Circuit breaker location identified at fire alarm panel, and properly identified at breaker panel location
- ☐ System is free of all trouble conditions
- ☐ System has been programmed to meet specification requirements
- ☐ Systems device text programming has been coordinated with the Owner to ensure proper device identity and location.
- ☐ Operating instructions provided at fire alarm control panel location
- ☐ All devices and components installed per approved shop drawings
- ☐ All devices properly labeled and properly identified on as-builts
- ☐ All conduit box covers in place
- ☐ No T-Tap connections or splices in circuits
- ☐ All T-Bar hangers in place where devices are installed on drop ceilings
- ☐ No flexible conduit exceeds 6 feet in length
- ☐ All concealed devices have remote lamps in visible areas
- ☐ All control relays located within 3 feet of controlled equipment
- ☐ All required surge suppressors properly installed (including required suppressors for F/A circuits leaving and entering buildings)
- ☐ Fire alarm network per contract requirements
- ☐ Alarm sound pressure dB readings have been taken in every area, with doors closed and all the areas met the required dB levels.

- ☐ Fire alarm communicating properly to Owner designated monitor station
 - ☐ Cellular dialer arranged for F/A communications to monitor station.
 - ☐ Spare parts provided
 - ☐ Systems training provided to Owner's personnel (could be done at final acceptance)
2. Visual Inspection: Conduct visual inspection prior to testing.
- a. Inspection must 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.
3. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
4. Measure sound pressure levels with a sound level meter meeting ANSI S1.4a Specifications for Sound Level Meters, Type 2 requirements.
- a. Measure sound pressure levels throughout the protected area to confirm that they are in compliance with NFPA 72.
- D. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.
- 3.9 DOCUMENT STORAGE BOX (CABINET)
- A. Install documentation cabinet at the fire alarm control panel.
 - B. At project completion, place documentation inside the documentation cabinet in accordance with NFPA 72.

3.10 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service must 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 must 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.

3.11 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning at Substantial Completion, service agreement must 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 must 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.

3.12 DEMONSTRATION AND TRAINING

- A. Engage a factory-authorized service representative to train Owner's personnel to adjust and operate fire-alarm system.
- B. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment.

- C. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following:
1. Basis of System Design, Operational Requirements, and Criteria: Include system and equipment descriptions, operating standards, regulatory requirements, equipment function, and operating characteristics.
 2. Documentation: Review emergency, operations, and maintenance manuals; Project Record Documents; identification systems; warranties and maintenance service agreements.
 3. Emergencies: Include instructions on procedures; operating instructions for conditions outside normal operating limits; instructions on meaning of warnings, trouble indications, and error messages; and required sequences for electronic systems.
- D. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- E. Provide video recordings of training modules in Digital Video Disc (DVD) format.

END OF SECTION 28 46 21

SECTION 28 48 13 - EMERGENCY RESPONDER COMMUNICATIONS ENHANCEMENT SYSTEM (ERCES)

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Emergency responder communications enhancement system (ERCES) equipment.
- B. Coordinate with the AHJ and perform tests in accordance with NFPA 1225, "In-Building Emergency Responder Communications Enhancement Systems," and the International Fire Code, Section 510, "Emergency Responder Communication Coverage" to determine the need for an Emergency Responder Communications Enhancement System.
 1. Tests shall be conducted, documented, and signed by personnel in possession of a current FCC General Radio Operator License.
 2. Perform radio signal coverage test in accordance with NFPA 1225, the International Fire Code, and as required by the local AHJ. Confirm that critical and general areas of the building have adequate radio coverage for public safety agencies that respond to events in the building.
 - a. Required minimum inbound and outbound signal strength: -95dBm.
 - b. Critical areas shall be provided with 99 percent floor area radio coverage.
 - c. General building areas shall be provided with 90 percent floor area radio coverage.
 3. If radio signal enhancement is required, provide systems, components and equipment required to provide emergency responder radio communication enhancement system.
- C. Provide systems, components and equipment required to provide emergency responder communications enhancement system in accordance with AHJ requirements and the following codes and standards:
 1. International Building Code (IBC).
 2. International Fire Code (IFC).

3. NFPA 1 – Fire Code.
 4. NFPA 70 – National Electrical Code
 5. NFPA 72 – National Fire Alarm and Signaling Code, Chapter 24 "Emergency Communications Systems."
 6. NFPA 1225 – Standard for Emergency Services Communications Systems.
 7. ANSI/UL 2524 – Standard for In-Building Two-Way Emergency Radio Communication Enhancement Systems.
 8. Federal Communications Commission, FCC 47 CFR.
- D. Obtain and pay for permits required for the installation of the Emergency Responder In-Building Two-Way Radio Communication Enhancement System.
- E. Coordinate with AHJ to determine the requirements of the Radio Enhancement System, including, but not limited, to the following:
1. Frequencies to be amplified.
 2. Maximum tolerated time delay (in microseconds).
 3. Permit process.
 4. Test plans and testing.

1.2 RELATED REQUIREMENTS

- A. Division 28 Section “Fire Alarm” for monitoring of radio communication enhancement system for the following:
1. Radio System
 - a. Donor antenna malfunction.
 - b. Active RF emitting device failure.
 - c. Low-battery capacity indication when 70 percent of the 12-hour operating capacity has been depleted.
 - d. System component failure.

2. BDA Power Supply
 - a. Loss of normal ac power.
 - b. Failure of battery charger.
 3. Communications link between fire alarm system and radio communication enhancement system.
- B. Division 26 for dedicated branch circuit for primary power source for radio communication enhancement system.
- C. Section 078413 "Penetration Firestopping" specifies materials and methods for sealing penetrations of rated walls and partitions referenced by this Section.
- D. Section 260526 "Grounding and Bonding for Electrical Systems" specifies grounding and bonding referenced by this Section.

1.3 DEFINITIONS

- A. AHJ: Authority Having Jurisdiction.
- B. Backbone: Primary segment of ERCES between donor antenna and distribution cabling.
- C. BDA: Bi-Directional Amplifier, also called Signal Booster or Public Safety Repeater.
- D. Critical Building Areas: Fire Command Centers, Fire pump rooms, exit stairs, exit passageways, elevator lobbies, standpipe cabinets, sprinkler sectional valve locations, and other areas deemed critical by the AHJ.
- E. DAQ: Delivered Audio Quality.
- F. DAS: Distributed Antenna System.
- G. dBm: Decibels-Milliwatts.
- H. Downlink: The signal from a base station to portable radios.
- I. ERCES: Emergency Radio Coverage Enhancement Systems.
- J. ERRCS: Emergency Responder Radio Coverage System
- K. FCC: Federal Communications Commission.

- L. GROL: General Radiotelephone Operator License.
- M. IB-PSC: In-building public safety communications.
- N. IBC: International Building Code.
- O. IFC: International Fire Code.
- P. LMR: Land Mobile Radio.
- Q. NICET: National Institute for Certification in Engineering Technologies, a division of the National Society of Professional Engineers (NSPE).
- R. NFPA: National Fire Protection Association.
- S. RF: Radio Frequency.
- T. UHF: Ultra-high frequency.
- U. Uplink: The signal from a portable radio to the base station.

1.4 PERFORMANCE REQUIREMENTS

- A. Design of radio enhancement system shall be approved by the AHJ.
- B. Delivered Audio Quality Level Minimum: DAQ 3.4
- C. A minimum inbound signal strength of -95 dBm or other signal strength as required by the AHJ shall be provided throughout the coverage area.
- D. A minimum outbound signal strength of -95dBm at the donor site or other signal strength as required by the AHJ shall be provided for the coverage area.
- E. Radio coverage shall be provided throughout the building as a percentage of floor area.
 - 1. Critical Areas: Provide with 99 percent floor area radio coverage.
 - 2. General Building Areas: Provide 90 percent floor area radio coverage.
- F. System shall include automatic alarming of malfunctions of the signal booster and battery system. Malfunctions shall be automatically transmitted to the central monitoring station via the building fire alarm control panel.

- G. Radio enhancement system shall have a pathway survivability of Level 1, Level 2, or Level 3.
- H. Design system to accommodate additional frequencies and change of frequencies. To maintain radio system coverage as it was originally designed, design the radio enhancement system to be capable of modification or expansion in the event frequency changes are required by the FCC or additional frequencies are made available by the FCC.
- I. Components utilized in the installation of the radio enhancement system, including, but not limited to repeaters, transmitters, receivers, signal boosters, cabling, fiber distributed antenna and system shall be approved by the AHJ and shall be compatible with the public safety radio communication system.

1.5 DELEGATED DESIGN SERVICES

A. Delegated Design Professionals:

- 1. Engage qualified RF design professional to design ERCES.

1.6 ACTION SUBMITTALS

- A. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Engineer and prior to system installation.
- B. Delegated Design Submittals: Include analysis data signed by delegated design professional(s) responsible for their preparation. Include FCC GROL license or IB-PSC certification information.
- C. Shop Drawings: Prepare and submit the following:
 - 1. Product Data: Manufacturer's data sheets including model numbers and listing information for equipment, devices and materials.
 - 2. Statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification.
 - 3. ERCES Drawings, Diagrams, and Supporting Documents:
 - a. Project general notes.
 - b. Include plans, elevations, sections, details, and attachments to other Work.
 - c. Floor plans to indicate final device and equipment locations.

- d. Device and cable symbol legend.
 - e. Device layout.
 - f. Block diagrams and cable/conduit routing.
 - g. Size, type, and number of conductors.
 - h. Cable sizes, termination locations and requirements. Distinguish between factory and field wiring.
 - i. Cable type identification.
 - j. Equipment layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
 - k. Routing of cable and conduits and point-to-point wiring diagrams.
 - l. Pathway class and survivability identification.
 - m. System communications details.
 - n. System sequence of operations.
 - o. System mounting details.
 - p. Detail assembly and support requirements.
 - q. Roof attachment and penetration details.
 - r. Secondary power calculations/battery size calculations.
 - s. Power connections.
 - t. The interface of fire safety control functions.
 - u. Critical Areas Coverage: Fire command center, fire pump room, exit stairs/passageways, elevators, elevator lobbies, sprinkler standpipe closets and sectional valves locations, and other areas deemed critical by authorities having jurisdiction.
4. Include lightning protection with donor antenna installation as required by adopted codes and standards and in accordance with manufacturers' instructions.

1.7 INFORMATIONAL SUBMITTALS

- A. Manufacturer's published instructions.
- B. Baseline Radio Signal Strength and Quality Testing Report:
 - 1. Detailed report indicating NFPA 1225 plotted interior radio signal strength or delivered audio quality score throughout building critical and general areas with construction of interior partitions and doors completed, but without ERCES installed.
 - 2. Approval from authorities having jurisdiction to omit ERCES installation within building areas where baseline radio signal strength testing demonstrates that minimum required radio signal strength values are provided within these areas.
- C. System Record of Inspection and Testing: Record copy of completed system acceptance testing.
- D. Field Reports:
 - 1. Manufacturer's field reports for field quality-control support.
 - 2. Manufacturer's field reports for system startup support.
 - 3. Field reports for voltage monitoring and adjusting.
 - 4. Field reports for infrared scanning.
 - 5. Field reports for software and firmware upgrades.

1.8 CLOSEOUT SUBMITTALS

- A. Warranty documentation.
- B. Maintenance service agreement.
- C. Operation and Maintenance Data: For radio enhancement system to include in emergency, operation, and maintenance manuals.
- D. Provide "Emergency Responder In-Building Two-Way Radio Communication Enhancement System" Record of Completion Documents.
- E. As-Built Drawings:

1. Include all system design parameters.
 2. Complete wiring diagrams showing connections between all devices and equipment.
 3. Riser diagram.
- F. Results from DAQ level test including the following:
1. A full report with grid locations.
 2. DAQ measurements.
 3. RF emitting device or system component gain values.

1.9 REGULATORY AGENCY APPROVALS

- A. Submittals for ERCES must include written authorization from the frequency license holder to operate the two-way emergency responder communications enhancement system identified in the submittal.

1.10 QUALIFICATIONS

- A. In-Building Public Safety Communications (IB-PSC) Technician Trainee: Having at least six months of experience and possessing active NICET IB-PSC Level I certification. Able to install passive and active ERCES equipment under direct supervision.
- B. In-Building Public Safety Communications (IB-PSC) Associate Engineering Technician: Having at least two years of experience and possessing active NICET IB-PSC Level II certification. Able to conduct surveys, to install, to commission, and to maintain ERCES systems under limited supervision.
- C. In-Building Public Safety Communications (IB-PSC) Engineering Technician: Having at least five years of experience and possessing active NICET IB-PSC Level III certification. Able to interpret and evaluate surveys, to layout, and to manage ERCES systems without supervision.
- D. In-Building Public Safety Communications (IB-PSC) Design Technician: Having at least two years of IB-PSC design experience and possessing active NICET IB-PSC Design Technician certification. Able to prepare shop drawing plans and details for ERCES in accordance with Project requirements, manufacturer's published instructions, site survey data, and design tools.

- E. General Radiotelephone Operator License (GROL) Designer: Having an active FCC Registration Number (FRN). Able to prepare shop drawing plans and details for ERCES in accordance with Project requirements, manufacturer's published instructions, site survey data, and design tools.

1.11 QUALITY ASSURANCE

- A. License or Certification of Personnel: All system designs, installation, testing, and maintenance shall be conducted, documented, and signed by an acceptable manufacturer or person in possession of a current radio licensing authority license, industry certification, professional electrical engineering license, or as required by the AHJ.
- B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of devices, components and equipment required for this Project.
- C. Testing Agency Qualifications: Qualified agency, with the experience and capability to conduct testing indicated.
 - 1. Tests shall be conducted, documented, and signed by a person in possession of a current FCC general radiotelephone operator license, acceptable manufacturer/industry certification, electrical engineering license, or as required by the AHJ.
- D. Source Limitations: Obtain radio enhancement system from single source from single manufacturer.
- E. Radio enhancement system components shall be designed, installed, tested, inspected, and maintained in accordance with the manufacturer's published instructions.
- F. 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 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following, or approved equal:
 - 1. Radio Solutions, Inc.

2. Gamewell-FCI (Honeywell)
3. Notifier (Honeywell)
4. Silent Knight (Honeywell)

PART 3 EXECUTION

3.1 GENERAL

- A. Assembly and installation of all components of the Emergency Responder Radio Communication Enhancement System shall comply with the following:
 1. Manufacturer's published installation wiring diagrams and instruction manuals.
 2. AHJ requirements.
 3. NFPA 70 National Electrical Code.
 4. NFPA 72 National Fire Alarm and Signaling Code.
 5. NFPA 1225 Standard for Emergency Services Communications Systems.
 6. International Building Code.
 7. International Fire Code.

3.2 WIRING METHODS

- A. Wiring and cable shall have a pathway survivability of Level 1, Level 2, or Level 3.
- B. Wiring Method: Install cables in raceways except within equipment consoles and cabinets.
 1. Where leaky feeder cable is utilized as the antenna, it shall not be required to be installed in metal raceway.
- C. Conceal raceway and cables except in unfinished spaces.
- D. Route riser coaxial cable through a 2-hour rated enclosure.
- E. Connections between riser and feeder coaxial cables:

1. Make connection between riser and feeder coaxial cables within an enclosure matching the building's fire rating and pathway survivability.
 2. Passage of cable in and out of enclosure shall be fire-stopped to the building's fire rating and pathway survivability.
- F. Connect feeder coaxial cables using hybrid coupler devices of a value determined by the overall design.
- G. Wiring within Equipment 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 POWER SUPPLIES

- A. Provide at least two independent and reliable power supplies for all RF emitting devices and components of the system: one primary and one secondary.
- B. Primary Power Source: Provide the primary power source from a dedicated branch circuit in accordance with NFPA 72.
- C. Secondary Power Source: Battery system and charger.

3.4 GROUNDING AND BONDING

- A. Comply with requirements in Division 26 Section, Grounding and Bonding for Electrical Systems.
- B. Provide grounding and bonding for lightning arrestor and antenna mast in accordance with NEC Article 810.

3.5 LIGHTNING PROTECTION

- A. Provide system with lightning protection that complies with NFPA 780, Standard for the Installation of Lightning Protection Systems.

3.6 INSTALLATION OF RACEWAYS

- A. Comply with requirements in Section 260533 "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.

3.7 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. Schedule acceptance test with AHJ.
 - 2. Schedule tests with at least seven days' advance notice of test performance.
 - 3. Acceptance test procedures and requirements shall be as directed by the AHJ.
 - 4. After installing radio enhancement system and after electrical circuitry has been energized, test for compliance with requirements.
 - 5. Operational Test: Perform tests in accordance with 2010 NFPA 72 "Two-Way Radio Communications Enhancement Systems."
- C. Inspection: Verify that components are properly labeled and interconnecting wires and terminals are identified.
- D. Radio enhancement system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.8 STARTUP SERVICE

- A. Perform startup service.
 - 1. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements.
 - 2. Complete installation and startup checks according to manufacturer's written instructions.

3.9 ACCEPTANCE AND TEST PROCEDURES

- A. Perform acceptance test for in-building emergency responder radio coverage enhancement system upon completion of installation.
 - 1. Schedule acceptance test with AHJ.

2. Acceptance test procedures and requirements shall be as directed by the AHJ.
- B. Test and inspect all system components in accordance with the manufacturers' published instructions.
- C. Perform radio signal coverage test in accordance with NFPA 72, NFPA 1225, the International Fire Code, and as required by the local AHJ.
 1. Test plan shall ensure testing throughout the building.
 2. Test procedures shall be as directed by the AHJ.
 3. Use the DAQ audio quality measurement system to determine proper system performance and coverage.
 - a. Obtain from the AHJ operational parameters required for usable voice communications for the systems in use by the public safety agencies.
 4. Confirm that critical and general areas of the building have adequate radio coverage for public safety agencies that respond to events in the building.
 - a. Critical areas shall be provided with 99 percent floor area radio coverage.
 - b. General building areas shall be provided with 90 percent floor area radio coverage.
 5. Conduct test using a calibrated portable radio of the latest brand and model used by the agency, talking through the agency's radio communications system.
 6. Measure gain values of all amplifiers and keep results on file with Owner so that measurements can be verified during annual tests.
 7. Use spectrum analyzer or other suitable test equipment to ensure spurious oscillations are not being generated by the subject signal booster. Conduct test at time of installation and during subsequent annual inspections.
- D. Tests shall be conducted, documented, and signed by personnel in possession of a current FCC General Radio Operator License or by a person approved by the AHJ.
- E. Submit test records along with system diagrams, equipment specifications, user manuals, RF link budget calculations, battery backup calculation and associated design data upon completion of the project.

3.10 ADJUSTING

- A. On-Site Assistance: Provide on-site assistance in adjusting system components to meet required conditions.

3.11 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain the emergency responder radio coverage enhancement system and equipment.

3.12 MAINTENANCE

- A. Emergency responder radio coverage system shall be maintained operational at all times.
- B. Inspect and test the emergency responder radio coverage system annually and when structural changes occur including additions or renovations that could materially change the original field performance tests. Tests shall be conducted, documented, and signed by personnel in possession of a current FCC General Radio Operator License or by a person approved by the AHJ.
- C. Perform all maintenance and testing in accordance with the requirements of NFPA 72, National Fire Alarm and Signaling Code and the International Fire Code.
- D. Test plan shall ensure testing throughout the building.
- E. Test procedures shall be as directed by the AHJ.

END OF SECTION 28 48 13

SECTION 31 10 00 - SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping, or sealing site utilities.
7. Temporary erosion and sedimentation control.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 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.

1.4 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. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- C. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.
- 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 shown on the Plans and as require by the DNREC Delaware Erosion & Sediment Control Handbook, current edition.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "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 015639 "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 shown on the Plans and as require by the DNREC Delaware Erosion & Sediment Control Handbook, current edition.
- B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations according to direction of the Owner.

3.4 EXISTING UTILITIES

- A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.
 - 1. Arrange with utility companies to shut off indicated utilities.
- B. 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 Architect not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Architect's written permission.
- C. 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 024119 "Selective Demolition."

3.5 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
 - 1. Unless noted otherwise, grind down stumps and remove roots larger than 3 inches in diameter, obstructions, and debris to a depth of 18 inches below exposed subgrade.
 - 2. Use only hand methods or air spade for grubbing within protection zones.
- 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.
- 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.

3.7 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

3.8 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 10 00

SECTION 31 20 00 - EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating and filling for rough grading the Site.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for concrete slabs-on-grade.
4. Excavating and backfilling trenches for utilities and pits for buried utility structures.

1.2 DEFINITIONS

A. Backfill: Soil 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 Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

- H. 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.
- I. 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.
- J. 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.
- K. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct pre-excavation conference at Project site.

1.4 INFORMATIONAL SUBMITTALS

- A. Material test reports.

1.5 FIELD CONDITIONS

- A. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth-moving operations.
- B. Do not commence earth-moving operations until plant-protection measures specified in Section 015639 "Temporary Tree and Plant Protection" are in place.

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 Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487, or Groups A-1, A-2-4, A-2-5, and A-3 according to AASHTO M 145, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7 according to AASHTO M 145, or a combination of these groups.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. 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.
- E. 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.
- F. 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.
- G. 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.
- H. Drainage Course: Narrowly graded mixture of washed 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.

2.2 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 to comply with local practice or requirements of authorities having jurisdiction.
 - 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 to comply with local practice or requirements of authorities having jurisdiction.

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. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding areas.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.4 EXCAVATION FOR 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 concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. Pile Foundations: Stop excavations 6 to 12 inches above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.
3. 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.

B. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, 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. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.5 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.6 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.

- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. For pipes and conduit less than 6 inches in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.

2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
3. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
4. 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 015639 "Temporary Tree and Plant Protection."

3.7 SUBGRADE INSPECTION

- A. Compact all subgrade locations with a pneumatic tamper. Do not tamp wet or saturated subgrades.
- B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer, without additional compensation.

3.8 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 Engineer.
 1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Engineer.

3.9 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.

3.10 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 033000 "Cast-in-Place Concrete."
- D. Initial Backfill: Place and compact initial backfill of subbase material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.
 - 1. 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.
- E. Final Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.
- F. Warning Tape: Install warning tape directly above utilities, 16 inches below finished grade, for water and sewer. See Plan details for depth of electric line warning tape.

3.11 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.

3.12 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.

3.13 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. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.
- C. 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 95 percent.
 - 2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.
 - 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 85 percent.
 - 4. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

3.14 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.
- 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.

3.15 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. Shape subbase course and base course to required crown elevations and cross-slope grades.
 - 2. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.

3. 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.

3.16 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 that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 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.

3.17 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform inspections:
- B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.
- C. 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.
- D. 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 Engineer.
- 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.

3.18 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.

- 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.

3.19 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.

END OF SECTION 31 20 00

SECTION 31 23 23 – FILL

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. Section 312323.43 - Geofoam: Rigid, lightweight foam plastic fill.:

1.2 REFERENCE STANDARDS

- A. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54- kg (10-lb) Rammer and a 457-mm (18 in.) Drop 2021, with Errata (2022).
- B. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates 2019.
- C. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)) 2012 (Reapproved 2021).
- D. ASTM D1556/D1556M - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method 2015, with Editorial Revision (2016).
- E. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)) 2012 (Reapproved 2021).
- F. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method 2015.
- G. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) 2017, with Editorial Revision (2020).
- H. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil Aggregate by Nuclear Methods (Shallow Depth) 2017a, with Editorial Revision (2021).

1.3 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data for Manufactured Fill.
- C. Shop Drawings for Manufactured Fill.
 - 1. Submit plan, section, and profile drawings. Indicate size, type, location, and orientation of each geofoam block.
 - 2. Submit location and type of connectors.
- D. Manufacturer's Qualification Statement.

E. Testing Agency Qualification Statement.

F. Specimen Warranty

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

1.5 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a five-year period after Date of Substantial Completion.

C. Provide ten-year manufacturer warranty for manufactured fill material.

PART 2 - PRODUCTS

2.1 FILL MATERIALS

A. Manufactured Fill - Geofoam: Rigid foam plastic blocks.

1. Material: Expanded polystyrene (EPS), clearly marked with manufacturer name and product type.

B. Manufactured Fill - Geofoam: See Section 312323.43.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify areas to be filled are not compromised with surface or ground water.

3.2 PREPARATION

A. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.

B. Compact subgrade to density equal to or greater than requirements for subsequent fill material.

C. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.

3.3 FILLING

- A. Employ a placement method that does not disturb or damage other work.
- B. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- C. Maintain temporary means and methods, as required, to remove all water while fill is being placed as required, or until directed by the Architect. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.

3.4 MANUFACTURED FILL INSTALLATION – GEOFOAM

- A. Provide finish grade free of holes and protrusions.
- B. Install 8 inch (200 mm) leveling pad of granular, permeable material approved by Architect.
- C. Place geofoam fill as indicated on drawings.
- D. Cut blocks with hot wire. Cutting with hand tools, with power tools, or by breaking block material is not permitted.
- E. Offset each layer of blocks 2 feet (610 mm) from adjacent rows.
- F. Rotate each layer of blocks 90 degrees (1.6 r) in the horizontal plane relative to previous layer.
- G. Connectors and Adhesive:
 - 1. Install connectors and adhesive as directed in geofoam manufacturer's written instructions.
 - 2. When mechanical connectors are used, install a minimum of two (2) connectors for each 4 feet by 8 feet (1.22 m by 2.44 m) section of material.
- H. Connectors and Adhesive: Install as indicated on shop drawings.
- I. Provide temporary weighing and guying required to protect geofoam material until soil cover or pavement is in place.
- J. Avoid damage to geofoam material during other construction activities. Replace or repair damaged geofoam.

3.5 FILL AT SPECIFIC LOCATIONS

END OF SECTION 31 23 23

SECTION 31 23 23.43 – (EPS) GEOFOAM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This section includes all product design, labor, equipment and services necessary to complete the rigid expanded polystyrene (EPS) geofoam work in accordance with the Contract documents.

1.2 RELATED SECTIONS

- A. Section 00 13 30 Submittal Procedures.

1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM C165, Standard Test Method for Measuring Compressive Properties of Thermal Insulations.
 - 2. ASTM C203, Standard Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation.
 - 3. ASTM C303, Test Method for Dimensions and Density of Preformed Block and Board-Type Thermal Insulation.
 - 4. ASTM C390, Practice for Sampling and Acceptance of Thermal Insulation Lots.
 - 5. ASTM D1621, Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
 - 6. ASTM D6817, Standard Specification for Rigid Cellular Polystyrene Geofoam.
 - 7. ASTM D7180, Standard Guide for Use of Expanded Polystyrene (EPS) Geofoam in Geotechnical Projects.
 - 8. ASTM D7557, Standard Practice for Sampling of Expanded Polystyrene Geofoam Specimens.

1.4 SYSTEM DESCRIPTION

- A. Performance Requirements: Provide EPS geofoam designed, manufactured and installed to maintain stated performance criteria without defections, damage or failure.

1.5 SUBMITTALS

- A. Product data:
 - 1. Submit manufacturer's printed design specifications, product design data and product literature in accordance with Section 01330 indicating:
 - a. Product performance criteria used to confirm capability to withstand specified design loads.
 - b. Provide product transportation, storage, handling and installation requirements.
- B. Reports [Certificates]:
 - a. Submit certificate of compliance for material properties from manufacturer representing sampling in accordance with ASTM D7557.
 - b. Provide proof of third party inspection certification program in place covering each product specified in this Section confirming compliance.

1.6 QUALITY ASSURANCE

- A. Installer qualifications: Upon request of Engineer submit proof of minimum three (3) years experience of same Work as described in this Section.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Refer to ASTM D7180 for basic considerations for the use of expanded polystyrene (EPS) geofoam in geotechnical projects.
- B. Protect geofoam material from prolonged exposure to sunlight (more than 2 weeks). Store geofoam blocks under light colored tarpaulins. Secure geofoam blocks against movement from wind at the storage location.
- C. Provide adequate protection of materials and works from damage by weather, traffic, fire and other causes.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Geofoam lightweight fill material:
 - 1. Block or planar rigid geofoam fill material as supplied by Qualified Manufacturers as providing minimum design compressive resistance to withstand design loads as specified on Contract Drawings.
 - 2. Minimum geofoam flexural strength shall meet ASTM D6817 and be determined in accordance with ASTM C203.

3. Minimum geofoam block density shall meet ASTM D6817 and be determined in accordance with ASTM C303.
 4. Minimum geofoam compressive resistance shall meet ASTM D6817 and be determined in accordance with ASTM C165 or D1621.
 5. Flame Spread and Smoke Development:
 - a. Material shall comply with ASTM E84 (UL 723) requirements:
 - 1) Maximum flame spread index: 25
 - 2) Maximum smoke developed index: 450
 - b. Material shall be manufactured with a flame-retardant additive and shall be labeled accordingly.
 - c. Submit certified test reports indicating compliance with these requirements.
- B. Timber Connectors: Double-faced spiked timber connector plates spaced as per project design requirements to secure each horizontal joint between courses of block where required. Obtain connector plates from supplier approved by EPS geofoam manufacturer.

PART 3 - PRODUCTS

3.1 MANUFACTURER'S INSTRUCTIONS

- A. Compliance: Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage, and installation instructions.

3.2 WORKMANSHIP

- A. Install EPS geofoam material after subgrade materials have been prepared.
- B. Cut and trim EPS geofoam block neatly to fit spaces. Butt joints tightly, offset vertical joints. Geofoam blocks should be free from chips or broken edges. Use largest possible dimensions to reduce number of joints.
- C. Offset both vertical and horizontal joints in multiple layer applications.

3.3 EXAMINATION

- A. Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Engineer. Commencement of Work means acceptance of existing conditions.

3.4 PREPARATION

- A. Verify subgrade surface is free from surface water, frozen matter or projections and other foreign matter detrimental to performance.
- B. Remove excess debris from exposed surfaces.
- C. Prohibit traffic on prepared areas until Work of this Section has been completed.
- D. Supply and install temporary protection to adjacent surfaces to prevent damage resulting from Work of this Section.

3.5 INSTALLATION

- A. Lay EPS geofoam fill material in position with staggered joints, as shown on EPS geofoam block layout plans.
- B. The bottom layer of geofoam block must be supported over its entire lower face, so a plane surface, inclined as appropriate, must be prepared. Departures from planarity may not exceed $\pm 3/8$ " in 10 feet. The leveling material used is generally sand; its thickness depends on the ground and the machines to be employed.
- C. Once geofoam blocks are in place, they should be covered as soon as possible. Suitable drainage measures must be taken. On sloping sites this is particularly important. If there is any possibility of flooding, buoyancy effects must be considered.

3.6 PROTECTION

- A. Provide adequate protection of Work from damage by weather, traffic, fire and other hazards during installation.

END OF SECTION 31 23 23.43

SECTION 32 13 13 - CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes concrete paving including the following:

1. Curbs and gutters.
2. Walks.

1.2 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.

1.3 QUALITY ASSURANCE

- A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

1.4 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on concrete paving mixtures.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

2.2 STEEL REINFORCEMENT

- A. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, fabricated from as-drawn steel wire into flat sheets.
- B. 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.

2.3 CONCRETE MATERIALS

- A. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:
 - 1. Portland Cement: ASTM C150/C150M, gray portland cement Type I or Type II.
 - 2. Fly Ash: ASTM C618, Class C or Class F.
 - 3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C33/C33M, Class 4S, uniformly graded. Provide aggregates from a single source.
- C. Air-Entraining Admixture: ASTM C260/C260M.
- 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 C94/C94M.

2.4 FIBER REINFORCEMENT

- A. Synthetic Fiber, Monofilament Fibers: Monofilament polypropylene fibers engineered and designed for use in decorative concrete paving, complying with ASTM C1116/C1116M, Type III, 1/2 to 1-1/2 inches long.

2.5 CURING MATERIALS

- A. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, dissipating.

2.6 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.
- 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.
 - 1. Fly Ash or Pozzolan: 25 percent.
 - 2. Slag Cement: 50 percent.
 - 3. Combined Fly Ash or Pozzolan, and Slag Cement: 50 percent, with fly ash or pozzolan not exceeding 25 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.
- D. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
- E. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd..
- F. Concrete Mixtures: Normal-weight concrete.
 - 1. Compressive Strength (28 Days): 3500 psi.
 - 2. Maximum W/C Ratio at Point of Placement: 0.45.
 - 3. Slump Limit: 1-3 inches..

2.7 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Furnish batch certificates for each batch discharged and used in the Work.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

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 INSTALLATION OF STEEL REINFORCEMENT

- A. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

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.
- 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.
- 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.
- 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, to match jointing of existing adjacent concrete paving:
- 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.

3.6 CONCRETE PLACEMENT

- A. 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.
- B. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

- C. 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.
- D. Screed paving surface with a straightedge and strike off.
- E. 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.

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. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
 - 2. 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. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.
- C. Slip-Resistive Aggregate Finish: Before final floating, spread slip-resistive aggregate finish on paving surface according to manufacturer's written instructions.
 - 1. Cure concrete with curing compound recommended by slip-resistive aggregate manufacturer. Apply curing compound immediately after final finishing.
 - 2. After curing, lightly work surface with a steel-wire brush or abrasive stone and water to expose nonslip aggregate.

3.8 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 curing compound.

3.9 PAVING TOLERANCES

- A. Comply with tolerances in ACI 117 and as follows:
 - 1. Elevation: 1/4 inch.
 - 2. Thickness: Plus 3/8 inch, minus 1/4 inch.
 - 3. Surface: Gap below 10-feet-long; unleveled straightedge not to exceed 1/2 inch.
 - 4. Joint Spacing: 3 inches.
 - 5. Contraction Joint Depth: Plus 1/4 inch, no minus.
 - 6. Joint Width: Plus 1/8 inch, no minus.

3.10 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. 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.
- C. 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 321313

SECTION 32 14 00 - UNIT PAVING

PART 1: GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Concrete unit pavers set on concrete sub-base.
 - 2. Steel edge restraints.

1.2 RELATED SECTIONS

- A. See Division 31 Earth Moving.

1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. C33, Standard Specification for Concrete Aggregates.
 - 2. C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - 3. C140, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
 - 4. C144, Standard Specification for Aggregate for Masonry Mortar.
 - 5. C936, Standard Specification for Solid Concrete Interlocking Paving Units.
 - 6. C979, Standard Specification for Pigments for Integrally Colored Concrete.
 - 7. C1645, Standard Test Method for Freeze-thaw and De-icing Salt Durability of Solid Concrete Interlocking Paving Units.
 - 8. D698, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,000 ft-lbf/ft³ (600 kN-m/m³)).
 - 9. D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 SUBMITTALS

- A. Product Data: For materials other than water and aggregates.
- B. Product Data: For brick and concrete unit pavers.
- C. Sieve Analyses: For aggregate setting-bed materials, according to ASTM C 136.
- D. Samples for Initial Selection: For each type of unit paver indicated.

- E. Samples for Verification: For full-size units of each type of unit paver indicated.
- F. Material Certificates: For unit pavers. Include statements of material properties indicating compliance with requirements, including compliance with standards. Provide for each type and size of unit.
- G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for unit pavers, indicating compliance with requirements.

1.6 QUALITY ASSURANCE

- A. Mockups: build mockups for each form and pattern of unit pavers and curb required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for the completed Work, including same base construction, special features for expansion joints, and contiguous work as indicated: 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.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store pavers on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

1.8 FIELD 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 Mortar and Grout:
 - 1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
 - 2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6. 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 pavers within 1 minute of spreading setting-bed mortar.

PART 2: PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of unit paver, joint material, and setting material from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

2.2 UNIT PAVERS

- A. Unit Pavers: Solid paving units made from normal-weight concrete with a compressive strength not less than 5000 psi, water absorption not more than 5 percent according to ASTM C936, and no breakage and not more than 1 percent mass loss when tested for freeze-thaw resistance according to ASTM C1645.
- B. Manufacturer: Techo Bloc, phone: (877)832-4625, email: info@techobloc.com (or approved equal).
- C. Product "SLEEK PAVERS"
 1. Thickness: 3 9/16"
 2. Face Size: 15 7/8" x 31 15/16"
 3. Color: standard color to be selected by Owner

2.3 CURBS AND EDGE RESTRAINTS

- A. Steel Edge Restraints: Manufacturer's standard extruded-aluminum edging (2.5" high x 2" base) with loops pressed from face to receive mounting pins at 1 per 12". Pins shall be 3/8" x 4" steel pins. Black finish.

2.4 AGGREGATE SETTING-BED MATERIALS

- A. Graded Aggregate for Subbase: Sound, clean compacted gravel complying with ASTM D 448 for Size 3/4".
- B. Stone Screenings for Leveling Course: Sound stone screenings complying with ASTM D 448 for Size No. 8.
- C. Polymeric Sand for Unit Paver Joints: Provide sand of color needed to produce required joint color.

- E. 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:
 - 1. Survivability: Class 2, AASHTO M 288.
 - 2. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
 - 3. Permittivity: 0.02 per second, minimum; ASTM D 4491.
 - 4. UV Stability: 50 percent after 500 hours' exposure, ASTM D 4355.

PART 3: EXECUTION

3.1 EXAMINATION

- A. Examine surfaces indicated to receive unit paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Where unit paving is to be installed over waterproofing, examine waterproofing installation, with waterproofing Installer present, for protection from paving operations, including areas where waterproofing system is turned up or flashed against vertical surfaces.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Proof-roll prepared subgrade according to requirements in Section 312000 "Earth Moving" to identify soft pockets and areas of excess yielding. Proceed with unit paver installation only after deficient subgrades have been corrected and are ready to receive subbase course for unit pavers.

3.3 INSTALLATION, GENERAL

- A. Do not use unit pavers with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in finished work.
- B. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.
- C. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.
 - 1. For unit pavers, a block splitter may be used.

- D. Handle protective-coated brick pavers to prevent coated surfaces from contacting backs or edges of other units. If, despite these precautions, coating does contact bonding surfaces of brick, remove coating from bonding surfaces before setting brick.
- E. Joint Pattern: As indicated on Drawings.
- F. Tolerances: Do not exceed 1/32-inch unit-to-unit offset from flush (lippage) or 1/8 inch in 10 feet from level, or indicated slope, for finished surface of paving.
- G. Provide edge restraints as indicated.
 - 1. Where concrete paving serves as edge restraint for concrete unit pavers, install concrete and allow to cure before installing unit pavers.
 - 2. Protect concrete paving from damage during installation of unit pavers.
 - 3. For metal edge restraints with top edge exposed, drive stakes at least 1 inch below top edge. Apply mortar cover for securing stake.

3.4 SETTING-BED APPLICATIONS

- A. Compact soil subgrade uniformly to at least 95 percent of laboratory density.
- B. Proof-roll prepared subgrade to identify soft pockets and areas of excess yielding. 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.
- C. Place aggregate subbase and compact to 100 percent of ASTM D 1557 maximum laboratory density, and screed to depth indicated.
- D. Place geotextile fabric over compacted base course, overlapping ends and edges at least 12 inches.
- E. Place leveling course and screed to a thickness of 1-1/2 inches, taking care that moisture content remains constant and density is loose and uniform until pavers are set and compacted.
- F. Treat leveling course with herbicide to inhibit growth of grass and weeds if necessary, as directed by Owner's Representative.
- G. Set pavers with joint width per manufacturer's tolerances, being careful not to disturb leveling base. If pavers have spacer bars, place pavers hand tight against spacer bars. Use string lines to keep straight lines.
 - 1. When installation is performed with mechanical equipment, use only unit pavers with spacer bars on sides of each unit.
- H. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a 3500- to 5000-lbf compaction force at 80 to 90 Hz. Use vibrator with neoprene mat on face of plate or other means as needed to prevent cracking and chipping of pavers.

Perform at least three passes across paving with vibrator.

1. Compact pavers when there is sufficient surface to accommodate operation of vibrator, leaving at least 36 inches of uncompacted pavers adjacent to temporary edges.
 2. Before ending each day's work, compact installed unit pavers except for 36-inch width of uncompacted pavers adjacent to temporary edges (laying faces).
 3. As work progresses to perimeter of installation, compact installed pavers that are adjacent to permanent edges unless they are within 36 inches of laying face.
 4. Before ending each day's work and when rain interrupts work, cover pavers that have not been compacted and cover leveling course on which pavers have not been placed with nonstaining plastic sheets to protect them from rain.
- I. Spread dry polymeric joint sand and fill joints immediately after vibrating pavers into leveling course. Vibrate pavers and add jointing sand until joints are completely filled, then remove excess sand. Leave a slight surplus of sand on the surface for joint filling.
- J. Do not allow traffic on installed pavers until sand has been vibrated into joints.
- K. Repeat joint-filling process 30 days later.

3.5 SETTING EDGE RESTRAINT

- A. Install edging material per manufacturers recommendations and notes on details.

3.6 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

END OF SECTION 321400

SECTION 32 93 00 – PLANTING

PART 1 – GENERAL

1.1 SUMMARY

- A. This section defines standards for plant selection, handling, installation and care from the project's start through substantial completion, guarantee period and final acceptance at end of the guarantee period.
- B. Section Includes:
 - 1. Furnish all labor, materials, equipment, and supplies and perform all operations required to complete landscaping work as shown on the drawings and hereinafter specified.
 - 2. Excavation of tree pits and planting areas to the required depth. Backfill & disposal of all excavated materials as required.
 - 3. Furnishing and planting of all plants, including woody and herbaceous plants.
 - 4. Installing, watering, staking, guying, and pruning (if directed) all plants until acceptance by Owner.
 - 5. Maintaining all installed plantings, including watering, until acceptance of the completed work under this Section.
 - 6. Guaranteeing and replacing sickly, dying and dead plants through a period of Two (2) years following acceptance of the completed work under this Section.
 - 7. Protecting all existing site features from damage during the work of this Section.
 - 8. Maintaining a clean work site throughout duration of planting operations. Clean up of site and removal of any debris at completion of work of this Section.

1.2 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Balled and Burlapped Stock: Exterior plants dug with firm, natural balls of earth in which they are grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of tree or shrub required; wrapped, tied, rigidly supported, and drum-laced as recommended by ANSI Z60.1.
- C. Bare-Root Stock: Exterior 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 minimum root spread according to ANSI Z60.1 for kind and size of exterior

plant required.

- D. Container-Grown Stock: Healthy, vigorous, well-rooted exterior plants grown in a container with 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 kind, type, and size of exterior plant required.
- E. Finish Grade: Elevation of finished surface of planting soil.
- F. Planting Soil: Native sandy soil mix.
- G. 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.
- H. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.
- I. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting mix.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
 - 2. Plant Photographs: Submit color photographs in digital format of each required species and size of plant material as it will be furnished to Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.
- B. Samples for Verification: For each of the following:
 - 1. Trees and Shrubs: Three Samples of each variety and size delivered to site for review. Maintain approved Samples on-site as a standard for comparison. Where not feasible, Landscape 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.
 - 2. Staking and components.

1.4 INFORMATIONAL SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Materials Lists: Within 45 days after award of the Contract, submit a complete list of all materials proposed to be furnished and installed (including sources) under this Section, demonstrating conformance with the requirements specified.
- C. Product certificates signed by manufacturers certifying that their products comply with specified requirements.
 - 1. Manufacturer's certified analysis for standard products.
 - 2. Analysis for other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
 - 3. Label data substantiating that plants, trees, and planting materials comply with specified requirements.
- D. Qualification data for firms and persons to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Owner's representatives and owners, and other information specified.
- E. Submit project schedule for approval by Owner's representative at least five days prior to planned start of work. Schedule must include milestone dates that are coordinated with other site trades and locations of work.

1.5 QUALITY ASSURANCE

- A. Codes and Standards: Perform all work in compliance with applicable requirements of governing authorities having jurisdiction.
- B. Installer Qualifications: Engage an experienced Installer who has completed landscaping work similar in material, design, and extent to that indicated for this Project and with a record of successful landscape establishment.
- C. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on the Project site during all times. Provide at least one English speaking person present at all times during execution of this portion of the work, who is thoroughly familiar with the type of plants being installed and the proper materials and methods for their installation, to direct all work performed under this Section. This person shall have a minimum of 5 years experience in handling the specified plants, and should have a set of prints of the project on site.
- D. Provide quality, size, genus, species, and variety of plants indicated on the Plans, in accordance with the applicable requirements of ANSI Z60.1 American Standard for Nursery Stock, revised 2014. The highest horticultural standards shall be practiced from

the time of plant purchase through delivery and installation on site to ensure health, vigor and establishment of all plants.

- E. Measurements: Measure trees according to ANSI Z60.1, revised 2014. 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. Take caliper measurements 6 inches (150 mm) above ground for trees up to 4-inch (100-mm) caliper size, and 12 inches (300 mm) above ground for larger sizes. Measure main body of tree for height and spread; do not measure branches or roots tip-to-tip.
 - 2. Other Plants: Measure with stems and foliage in their normal position.
- F. All plants are subject to approval by Owners Representative (OR) who may inspect plants either at place of growth or at site before planting, for compliance with requirements for genus, species, variety, size, and quality. Owners Representative retains the right to further inspect plants for size and condition of balls and root systems, insects, injuries and latent defects, and to reject unsatisfactory or defective material at any time during progress of work and during contract period. Contractor shall remove rejected plants from project immediately and replace with approved replacement, at appropriate planting time, at no cost to Owner..
 - 1. Notify Landscape Architect of sources of planting materials seven days in advance of delivery to site. For woody plants and trees: Label at least one (1) plant of each variety and size with a securely attached, waterproof tag bearing legible designation of botanical and common name.
- G. All plants are to be provided as specified. Requests to use plant substitutes, whether for size or species/cultivar, shall be submitted in writing to the Owner's representative for client review and approval, prior to delivery to the job site.
- H. Nomenclature and interpretation of plant names shall reference the following. Where the names of plant descriptions disagree, the most current information will prevail:
 - 1. The Royal Horticultural Society Horticultural Database (<http://www.rhs.org.uk/>).
 - 2. USDA – The Germplasm Resources Information Network :
 - 3. <http://www.ars-grin.gov/>
 - 6. Manual of Woody Landscape Plants; Michael Dirr; Stipes Publishing, Champaign, Illinois; Most Current Edition.
- I. Plants of a larger size may be used if acceptable to Owner's Representative with a proportionate increase in size of roots or balls, and at no additions to the Contract Price
- J. All plants shall comply with State and Federal laws, including quarantines with respect

to inspection, plant diseases and insect infestation

K. Collected plants may be used only when approved by the Owner's Representative.

L. Equipment:

1. Provide machinery and equipment necessary for the prompt, professional completion of the work. Such machinery and equipment shall be adequate to the task required and shall be operated by a person skilled and experienced in both operation of the equipment and the implementation of the task.
2. Upon request, promptly furnish satisfactory evidence of the organization and equipment to be made available for the performance of the work.
3. Comply with all Federal and State Department of Agriculture regulations for pest control which, in general, require that contractors operating in infested areas thoroughly clean all equipment units before moving them to non-infested areas. Full information can be obtained from Federal and State Pest Control Personnel.

M. Documentation and Coordination:

- 1 Submit, upon request, documentation prior to the start of work under this Section that all plants and related materials have been ordered.
- 2 Plant delivery to site and timing of installation is to be coordinated with Owner's Representative prior to delivery of plants to site.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery and while stored at site.
- B. Trees: Deliver freshly dug trees. Do not prune before delivery, except as approved by Owner's Representative.. Protect bark, branches, and root systems from sun scald, desiccation and drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees in such a manner as to destroy natural shape. Provide protective covering during delivery to prevent wind burn.
- C. Handle balled and burlapped stock by the root ball only; do not stand on or tamp directly on root balls.
- D. Container Plants: Deliver all plants to site in containers that ensure the protection of entire plant including roots and other plant parts against climatic and other injuries. Plants shall be grown or established in containers in which they will be delivered for at least 8 months but not for more than 24 months in advance of final planting. Plants shall be fully rooted into container but not root-bound. Plants with cracked or broken balls of earth when taken from the containers shall not be planted unless acceptable to the Owner's Representative.

Do not lift or handle container plants by tops, stems, or trunks at any time.

- E. Deliver trees and plants after preparations for planting have been completed and install immediately. If planting is delayed more than 6 hours after delivery, set planting materials in shade, protect from weather and mechanical damage, and keep roots moist. Properly protect plants with soil, moist mulch, etc.,
 - 1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material, if not installed within six hours from delivery.
 - 2. Root balls/plants shall not be permitted to remain un-installed or exposed during periods of freezing weather or extreme weather conditions.
 - 3. Do not remove container-grown stock from containers before time of planting.
 - 4. Water root systems of trees stored on site as often and thoroughly as necessary to maintain root systems in a moist condition.

1.7 PROJECT CONDITIONS

- A. Utilities: Determine location of above grade and underground utilities and perform work in a manner that will avoid damage. Hand excavate, as required. Maintain grade stakes until removal is mutually agreed upon by parties concerned. The Contractor shall be responsible for the location and protection of all utilities and for repair of any utilities damaged by Contractor's work. Any damage shall be replaced/repaired to Owner's satisfaction at the Contractor's expense.
- B. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Owner's representative before planting.
- C. Work notification: Notify Owner's Representative at least five (5) working days prior to the start of work of this Section.

1.8 COORDINATION AND SCHEDULING

- A. Planting times shall be during one of the following periods. Coordinate planting periods with maintenance periods, as applicable, to provide required maintenance through date of final acceptance.

Spring Planting: April 26 – June 15 (frost-hardy and acclimatized plant material may be planted prior to April 26 and when not restricted by inclement weather limitations).

- 1. Fall Planting: September 1 – October 15 (plant material may be planted after October 15 and when not restricted by inclement weather limitations).
- 2. Summer Planting: to be performed on a project by project basis when not restricted by extreme heat and drought conditions, and when a water source and watering

equipment are provided and are easily accessible.

3. Dig trees according to the best recommended time, as per fall and/or spring dig hazards. Coordinate planting periods with maintenance periods to provide required maintenance thru date of Substantial Completion.
- B. Proceed with planting only when existing and forecasted weather conditions permit. If projected or current weather will stress plants, reschedule planting/installation times and dates

1.9 PLANT MATERIAL QUANTITIES

- A. In the event that quantity discrepancies or material omissions occur between the Plant List and Planting Plan, Contractor is to immediately notify Owner's Representative for clarification and to receive instruction about how to proceed.

1.10 MAINTENANCE

- A. Maintain for the following maintenance period by pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, tightening and repairing stakes and guy supports, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray as required to keep trees and shrubs free of insects and disease. Revise duration of maintenance period below to suit Project. Revise starting date of maintenance period to date of planting completion if preferred.
- B. Maintenance Period: Until date of Final Acceptance, as confirmed in writing by the Owner.

1.11 SOIL ANALYSIS

- A. Soil Analysis: Upon request, obtain analysis of soil from an accredited soil laboratory at the cost of the Landscape Contractor or Project to determine pH and necessary amendments and fertilizers.

1.12 SUBSTANTIAL COMPLETION AND START OF GUARANTEE PERIOD

- A. Upon written notice from the Contractor, the Owner's Representative shall review the work and make a determination if the work is substantially complete.
- B. The date of Substantial Completion of the planting shall be the date when the Owner's Representative accepts that all work in Planting is complete.
- C. All plants must be in a vigorous growing condition at the time of Substantial Completion.
- D. The Plant Guarantee period begins at the date of written notification of Substantial Completion from the Owner's Representative. The date of Substantial Completion for

planting may be different than the date of substantial completion for the other sections of the project.

1.13 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: Warrant the following living planting materials for a period of two (2) years after the date of Acceptance of Installation, against defects including death and unsatisfactory growth, except for defects resulting from neglect or abuse by Owner, abnormal weather conditions unusual for warranty period, or incidents that are beyond Contractor's control.
 - 1. Trees and Shrubs
 - 2. Herbaceous and groundcover plants
- C. Replace at the direction of the Owner's Representative and in accordance with the Drawings and Specifications, all plants that are dead (all material that is at least 25% dead, and any tree with a main leader that has died back), plants that are in unhealthy or unsightly condition, plants that have lost their natural shape due to dead branches, or other causes due to the Contractor's negligence.
- D. All replacements shall be plants of the same kind, size, and quality as originally specified.
- E. Warranty shall not include damage or loss of plants caused by fires, floods, freezing rains, lightning, winds over 75 miles per hour, winter kill caused by severe winter conditions not typical of the planting area, by acts of vandalism, or by negligence on the part of the Owner.
- F. Replaced plants shall be procured, planted, and watered as part of the warranty.

PART 2 – PRODUCTS

2.1 GENERAL

- A. All plants shall be sourced locally and be the kind and size indicated on the plant list and shall be true to name. All plants shall be sound, healthy, vigorous, nursery stock with a normal habit of growth, shall be subjected to nursery root and top spraying, transplanting, etc., and shall have been inspected and approved for sale, transporting and transplanting by all governmental agencies authorized to administer such control. Plants shall be subject to inspection and approval by the Owner's Representative at place of growth and upon delivery to project site for conformity to specifications. Such approval shall not

impair the right of inspection and rejection during process of the work. All trees will be tagged in the nursery by the Owner's Representative.

- B. All plants shall be subject to inspection and approval by the Owner's Representative throughout Contract period. All plants are subject to approval by Owner's Representative. The Contractor must submit to the Owner's Representative a letter of certification from the supplying nurseries that plants supplied to the contractor conform to the requirements listed below:
 - 1. Provide trees of sizes and grades conforming to ANSI Z60.1 for type of trees required. Trees of a larger size may be used if acceptable to Owner's representative with a proportionate increase in size of roots or balls, and at no additions to the Contract Price.
- C. Prior to delivery to the site, the Contractor shall arrange with the Owner's Representative a minimum of two nursery visits for the purpose of selecting and tagging plants proposed for the project. This will include all trees as specified. The Owner's Representative shall inspect proposed plants before plants will be permitted on site.
- D. Label at least one (1) tree of each variety and caliper with a securely attached, waterproof tag bearing legible designation of botanical and common name.
- E. Trees with multiple leaders, unless specified, will be rejected

2.2 SHADE AND FLOWERING TREES

- A. Shade trees: Single-stem trees with straight trunk, well-balanced crown, and intact leader, free of branches to about 50% of their height, of height and caliper indicated, conforming to ANSI A300 Section 6 for type of trees required.
- B. Provide balled and burlapped trees except where indicated.
 - 1. Container-grown trees will be accepted in lieu of balled and burlapped trees subject to meeting ANSI A300 Section 6 limitations for container stock.

2.3 DECIDUOUS SHRUBS

- A. Form and Size: Deciduous shrubs with not less than the minimum number of canes required by and measured according ANSI A300 Section 6 for type, shape, and height of shrub.

2.4 CONIFEROUS EVERGREENS

- A. Form and Size: Normal-quality, well-balanced, coniferous evergreens, of type, height, spread, and shape required, complying with ANSI A300 Section 6.

- B. Form and Size: Specimen-quality, exceptionally heavy, tightly knit, symmetrically shaped coniferous evergreens:

- 1. Provide balled and burlapped trees.

2.5 BROADLEAF EVERGREENS

- A. Form and Size: Normal-quality, well-balanced, broadleaf evergreens, of type, height, spread, and shape required, complying with ANSI A300 Section 6.

- 1. Provide balled and burlapped or container plants as per plant schedule.

2.6 GROUNDCOVER PLANTS

- A. Groundcover: Provide groundcover of species indicated, established and well rooted in pots or similar containers, and complying with ANSI Z60.1.

2.7 HERBACEOUS PLANTS

- A. Annuals: Provide healthy, disease-free plants of species and variety shown or listed. Provide only plants that are acclimated to outdoor conditions before delivery and that are in bud but not yet in bloom.

- B. Perennials: Provide healthy, field-grown plants from a commercial nursery, of species and variety shown or listed.

- C. Vines: Provide vines of species indicated complying with requirements in ANSI Z60.1 as follows:

- 1 Two-year or older plants with heavy, well-branched tops, with not less than 3 runners 18 inches or more in length, and with a vigorous well-developed root system.
 - 2 Provide field-grown vines. Vines grown in pots or other containers of adequate size and acclimated to outside conditions will also be acceptable.

2.8 REQUIREMENTS FOR BALLED AND BURLAPPED STOCK

- A. Where indicated to be balled and burlapped, provide trees dug with firm, natural ball of earth in which they are grown free of noxious weed matter.

- B. Provide ball size of not less than diameter and depth recommended by ANSI Z60.1 for type and size of tree required. Increase ball size or modify ratio of depth to diameter as required to encompass fibrous and feeding root system necessary for full recovery of trees subject to unusual or non-typical conditions of growth, soil conditions or horticultural practice.

- C. No balled and burlapped plant will be accepted if the ball is cracked or broken either before or during the process of planting. Root balls shall be firmly wrapped with burlap and bound with natural twine or wire mesh
- D. Wrap and tie earth ball as recommended by ANSI Z60.1 for size of balls required. Drum-lace balls with a diameter of 30" or greater.

2.9 CONTAINER STOCK

- A. Container stock shall be grown in its delivery container for not less than six (6) months but not more than 2 years.
- B. Plants shall have well established root systems but not be root-bound.
- C. Plants with cracked or broken balls of earth when taken from the containers shall not be planted.

2.10 BARE-ROOT STOCK

- A. Bare-root stock should have a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for kind and size typical of its species.
- B. Plants should be sufficiently packaged and stored to preserve moisture in fibrous root systems to ensure the health and vigor of the plant.

2.11 PLANTING SOIL MIX

- A. Planting Soil Mix: Mix native sandy soils with the following soil amendments and fertilizers in the following quantities:

Ratio of organic leaf mulch to native sandy soil by Volume: 1:4

2.12 SOIL AMENDMENTS:

- A. Fertilizer: "dryROOTS2" root growth enhancer and soil conditioner or approved equal. Apply to soil surface at manufacturer's recommended rates after planting.
- B. Organic Leaf Mulch: Apply to trees and perennials only. Do not use with grasses.

2.13 ANTI-TRANSPIRANT:

- A. Shall be "Wilt-Pruf" by Nursery Specialty Products, Inc., 207 East 47th Street, New York, NY 10017, or approved equal, applied as specified by the manufacturer to species as indicated in drawings.

2.14 WATERING EQUIPMENT

- A. Watering Equipment – to be provided on a project-by-project basis, and to remain the property of the Owner at the completion of the project:
 - 1. Gator Bags
 - 2. Ooze Tubes sufficient for watering multi-stem trees or shrubs.
 - 3. Soaker Hose -should be black or dark color which could blend with mulch, and that can be used above or below soil/mulch surface, will not burst if frozen and provides even distribution of water throughout the planting area. Installed as per manufacturer's specifications and as directed by project.

2.15 STAKES AND GUYS FOR TREES

- A. Stakes, anchors, and wires shall be of sufficient strength to maintain the tree in an upright position in the conditions in which the tree will be installed.
- B. Guy wires shall be galvanized, multi-strand, twisted wire.
- C. At the location where guy wires are attached around the tree, the trunk shall be protected with 20-mm (3/4 in.) diameter rubber hose, black or dark green in color, and of sufficient length to extend past the trunk by more than 105 mm (6 in).

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive landscaping for compliance with requirements and for conditions affecting performance of work of this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Verify that planters have been waterproofed and inspected.
- C. Verify the required drainage and irrigation rough-in has been installed and is fully operational.
- D. Verify that subgrades are accurately established before spreading soil mix.
- E. Once bed preparation has been approved, the Landscape Contractor assumes responsibility for subgrades and finish grades in the areas affected.

3.2 PLANT PRUNING

- A. Prune, thin, and shape trees according to standard horticultural practice and as directed by owner's representative. Prune trees to retain required height and spread. Unless otherwise directed by Owner's Representative, do not cut tree leaders; remove only crossing, injured or dead branches.

3.3 PLANTING AREA PREPARATION

- A. Loosen subgrade of planting areas, as needed, to promote adequate drainage and soil conditions promoting plant health and root establishment, but which prevents settlement below finished grade of plantings. Remove all trash from subgrade along with stones and extraneous debris larger than 1" or that will prevent proper installation and establishment of plantings.
- B. All stumps, weeds, vegetation not being retained are to be grubbed out and/or removed.
- C. Install native sandy soil mix in 6" lifts, gently compacted using hand tamping, to a depth that meets finished grades after natural settlement but which ensures root and plant establishment. Do not spread if soil mix or subgrade is frozen, muddy, or excessively wet. Do not over compact soil mix; compaction is subject to review and alteration.
 - 1. Thoroughly blend any fertilizer needed, as per soil test results, into planting soil either before installation of soil lifts, or as lifts are being installed and before tamping. Delay mixing fertilizer with planting soil if planting will not occur within a few days.
- D. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture, ensuring soil surface is free from debris. Rake, remove ridges, and fill depressions to meet finished grades.
- E. Restore planting areas if eroded or otherwise disturbed after finish grading and before planting.
- F. Minimize soil disturbance in areas under existing tree canopy or on sloped areas.
- G. Planting areas and tree rings are to be vertically edged with a hand spade or mechanical edger to a minimum depth of 4". The elevation of the planting area starts at the low point of the cut edge and angles back towards the planting at a 45 degree angle until it reaches the finish grade of the planting areas. Work excess soil back into planting areas.

3.4 PLANTING PIT PREPARATION FOR TREES

- A. Verify that subgrades are accurately established before digging tree pit.
- B. Dig a hole so that depth will enable tree to be installed in a manner that allows the root flare to be at or slightly above Finished Grade after normal compaction, and at the same relationship to finished grade as they were to the ground from which they were dug.
 - 1. C. Planting hole should be 2 – 3x wider than the size of the root ball.

3.5 DELIVERY, STORAGE AND HANDLING

- A. Plants must be sufficiently containerized, packaged, tarped, etc. to ensure viability of plants and the protection of roots and other plant parts against sun scald, drying, sweating, whipping, and other handling damage as well as climatic seasonal and other injuries.
- B. Trees: Deliver freshly dug trees. Do not prune before delivery, except as approved by Owner's Representative. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees in such a manner as to destroy natural shape. Provide protective covering during delivery to prevent wind burn. Do not drop trees during delivery.
- C. Water all trees and plants as needed from time of pick up through substantial completion.
- D. Do not lift or handle container plants by tops, stems or trunks at any time.
- E. Handle balled and burlapped stock by the root ball only; do not stand on or tamp directly on root balls.
- F. Deliver trees and plants after preparations for planting have been completed and install immediately. If planting is delayed more than 6 hours after delivery, set planting materials in shade, protect from weather and mechanical damage, and keep roots moist. Properly protect plants with soil, moist mulch, etc., in a manner acceptable to Owner's Representative.
 - 1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material, if not installed within six hours from delivery.
 - 2. Root balls/plants shall not be permitted to remain un-installed or exposed during periods of freezing weather or extreme weather conditions.
 - 3. Do not remove container-grown stock from containers before time of planting.
 - 4. Water root systems of trees stored on site as often and thoroughly as necessary to maintain root systems in a moist condition.

3.6 LAYOUT

- A. Layout specifications and area and perimeter measurements are provided as guidelines only, and are to be confirmed in the field by Contractor(s) and adjusted as necessary and collaboratively with Owner's Representative.
- B. The location of new plants and new planting areas are to be staked out in collaboration with and approved by the Owner's Representative prior to installation.

3.7 PLANT INSTALLATION

- A. All root balls removed from containers will be scarified and roots thoroughly separated prior to planting.
- B. All plastic or no-rot burlap or twine are to be completely removed from the plant ball prior to backfilling with planting soil. Biodegradable burlap and twine and wire cage material shall be cut away from the top 1/3 of the root ball and remove from the site.
- C. When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, stop work and notify Owner's Representative for additional direction.
- D. Set plant plumb and in center of planting pit or trench with top of ball raised just above adjacent finish grade enough to allow for normal compaction and sufficient final planting depth, and so surface of root system will be flush with adjacent finished grades after normal settling.
- E. Maintain full depth of planting soil around root system of plants.
- F. Place soil around ball in layers, tamping gently to settle backfill and eliminate voids and air pockets -do not over tamp. When pit is approximately half backfilled, water thoroughly before placing remainder of backfill

3.8 STAKING AND GUYING – TREES:

- A. Guy and stake trees more than 2.5 -3-inch (75-mm) caliper, unless otherwise indicated, in situations such as sandy or poor soils, in windy locations, or on slopes. Trees that settle out of plumb due to inadequate soil compaction either under or adjacent to the root ball shall be excavated and reset. Trees that have settled out of plumb shall never be pulled straight using guy wires.

3.9 PROTECTION, CLEAN-UP AND MAINTENANCE

- A. During landscape installation, keep pavements clean and work area in an orderly condition. Place 3/4" plywood as needed to protect existing turf, paved areas, etc.
- B. Install plastic safety fencing as needed to provide barrier protection for newly planted areas or areas to be preserved.
- C. Protect new plantings and plants to remain from damage due to landscape operations, operations by other contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damage to new or existing plantings at the expense of the Landscape Contractor.
- D. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash,

and debris, and legally dispose of it off the Owner's property.

- E. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, tightening and repairing stakes and guy supports, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray as required to keep trees free of insects and disease. Maintain throughout project work period until Substantial Completion. All plantings which appear to be in distress or defective shall be removed immediately and replaced or replanted according to planting times and quality as defined in this section, with specimens of the same species and size as originally specified:
- F. Watering:
 - 1. The contractor shall be fully responsible to ensure that adequate water is provided to all plants throughout the work period until the date of Substantial Completion.
 - 2. Hand water root balls of all plants to ensure that the root balls have moisture above wilt point and below field capacity, and appropriate for the species. As needed, moisture content in each root ball and soil outside the root ball can be tested to determine water content.
- G. Guy Wires and Stakes are to be maintained by Contractor until the end of the Guarantee Period (see section 3.10) to avoid girdling throughout the first growing season, and removed after the first growing season if site conditions and adequate plant establishment permit.

3.10 ACCEPTANCE AND GUARANTEE

- A. Plants are to be guaranteed as per the following list, starting from the time of Substantial Completion. Defective materials shall be removed immediately and replaced according to planting times and quality as defined in this section, with specimens of the same species and size as originally specified, with new guarantee for the replacement plant starting at time of replacement. Written Final Acceptance shall be provided at the end of the guarantee period by Owner Representative once all conditions of this Section have been met. All plants must be in a vigorous growing condition at the end of the guarantee period:
 - 1. Minimum of 2-year guarantee on all newly installed plant material.
- B. When Maintenance after Substantial Completion is by others, and not awarded to the Contractor:
 - 1. After Substantial Completion Acceptance, the Contractor shall make sufficient site visits to observe the Owner's maintenance and notify the Owner's Representative in writing if maintenance, including watering, is not sufficient to maintain plants in a healthy condition. Such notifications must be made in a timely period so that the

Owner can take corrective action and/or schedule a time to review with the Contractor prior to taking corrective action. Notification must define the maintenance needs observed, include a date and request for site review.

2. In the event that the Contractor fails to visit the site and/ or notify the Owner's Representative in writing, with confirmation that Owner's Representative received the notification, lack of maintenance shall not be used as grounds for voiding or modifying the provisions of the warranty.
- C. Contractor is to be responsible for contacting Owner's Representative defined at the start of this section (1) one month prior to end of guarantee period to review health and successful establishment of plantings. Guarantee remains in effect until this final review takes place.

END OF SECTION 32 93 00

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SECTION 33 42 00 - STORMWATER CONVEYANCE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. PVC pipe and fittings.
2. Non-pressure transition couplings.
3. Cleanouts.
4. Stormwater inlets.
5. Pipe outlets.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Catch basins and stormwater inlets. Include plans, elevations, sections, details, frames, covers, and grates.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.
- B. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet and vertical scale of not less than 1 inch equals 5 feet. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.
- C. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

- A. NSF Marking: Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic storm drain and "NSF-sewer" for plastic storm sewer piping.
- B. PVC Corrugated Sewer Piping:
 - 1. Pipe: ASTM F949, PVC, corrugated pipe with bell-and-spigot ends for gasketed joints.
 - 2. Fittings: ASTM F949, PVC molded or fabricated, socket type.
 - 3. Gaskets: ASTM F477, elastomeric seals.
- C. Adhesive Primer: ASTM F656.
- D. PVC Schedule 40 Sewer Piping:
 - 1. Pipe: ASTM D 1784, PVC solid wall pipe.
 - 2. Fittings: ASTM D 1784, PVC fabricated type.

2.2 CLEANOUTS

- A. PVC Cleanouts:
 - 1. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.3 DRAIN BASINS

- A. Basin: Manufactured from PVC pipe stock, utilizing a thermoplastic molding process to reform the pipe stock.
- B. Grates and Covers: Heavy duty high density polyethylene or cast iron.

2.4 PIPE OUTLETS

- A. Riprap Basins: Broken, irregularly sized and shaped, graded stone in accordance with NSSGA's "Quarried Stone for Erosion and Sediment Control."
 - 1. Average Size: NSSGA No. R-5, screen opening 5 inches.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."

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 into account design considerations. 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 in accordance with manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
- C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
- F. Install gravity-flow, nonpressure drainage piping in accordance with the following:
 - 1. Install piping pitched down in direction of flow.
 - 2. Install piping with 30- inch-minimum cover.
 - 3. Install PVC sewer piping in accordance with ASTM D2321 and ASTM F1668.

3.3 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, nonpressure drainage piping in accordance with the following:
 - 1. Join PVC corrugated sewer piping in accordance with ASTM D2321 for elastomeric-seal joints.
 - 2. Join dissimilar pipe materials with nonpressure-type flexible couplings.

3.4 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. 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 Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
 3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
 4. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.
- 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(es) above surrounding earth grade.
- C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.5 IDENTIFICATION

- A. Materials and their installation are specified in Section 312000 "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.
1. Use detectable warning tape over ferrous piping.
 2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.6 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
1. Submit separate reports for each system inspection.
 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Damage: 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 in accordance with 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. Gravity-Flow Storm Drainage Piping: Test in accordance with requirements of authorities having jurisdiction, UNI-B-6, and the following:
 - a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
 - b. Option: Test plastic piping in accordance with ASTM F1417.
- C. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.7 CLEANING

- A. Clean interior of piping of dirt and superfluous materials. Flush with water.

END OF SECTION 334200

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